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ABSTRACT

The study was divided into three major phases: to develop a mathematics curriculum for educable mentally handicapped; to develop a measurement instrument to evaluate the children's learning at various cognitive levels; and to determine the relative effects of two instructional approaches (inductive and deductive), two forms of repetition (exact and varied) and two modes of representation (manipulative and non-manipulative) on the children's mathematical learning. Seventy two subjects from two elementary schools were selected and placed in one of eight program conditions. It was found that the total program, when IQ was allowed to vary, resulted in significant amounts of learning at various cognitive levels. Manipulative modes of application were noted as better facilitating synthesis level than did nonmanipulative modes of application. The inductive mode of presentation was felt to facilitate the learning of set operations better than the deductive mode, and the two forms of repetition equally facilitated all types of mathematical learning. (CD)

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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Mathematics Curriculum Innovation and Evaluation
for Educable Mentally Retarded

Introduction

This study was divided into three major phases to accomplish the following objectives: I. to develop a mathematics curriculum of programmed instruction for Educable Mentally Retarded (EMR) and to evaluate the program's effectiveness in facilitating EMR learning globally, at various cognitive levels, and within different mathematical areas; II. to develop a measurement instrument which could be used to assess EMR learning globally, at various cognitive levels, and within different mathematical areas; and III. to determine the relative effects of two instructional approaches (inductive and deductive), two forms of repetition (exact and varied) and two modes of representation (manipulative and non-manipulative) on the mathematical learning of EMR's globally, at each of six cognitive levels, and within various mathematical areas.

Review of Related Literature

In a recent survey, a random sample of teachers of the mentally retarded in the State of Wisconsin were asked which programs in mathematics they used with their pupils. The two mathematics programs most frequently chosen by these teachers were the Stenk, Vaughn and McCormick-Mathers series respectively (Armstrong and Denaij, In Preparation). These programs, originally designed for use with normals rather than EMR's are quite traditional in content, scope, and instructional approach. Major emphasis is placed upon drill and practice on the basic facts of the four operations. The third most frequently occurring response was teacher-made materials.

Due to the lack of research evidence available on just what qualities or characteristics programs should have to better facilitate the learning of EMR's, there is little reason to make claims that the materials being used, although originally designed for children of "normal" intelligence, fail to maximize EMR learning potential. There is, however, accumulating evidence that the more modern (understanding) approaches to mathematical learning for normals has been overall more successful in facilitating mathematical learning than the more traditionally based approaches (Begle, 1969; Fennema, 1969). There is also evidence from literature in developmental psychology to indicate substantial developmental lag in the mentally retarded. For example, the EMR progresses much more slowly (Woodward, 1961) than the child of normal intelligence through

the developmental stages hypothesized by Piaget (Flavell, 1963). Consequently, one would expect that mathematics programs designed for the EMR should be adjusted to compensate for this lag in development. The EMR of chronological age (CA) seven to eleven would generally be in the pre-operational (intuitive) stage of development (Woodward, 1961) while normals of the same CA would be at the concrete operations stage.

Since children of normal intelligence at a younger chronological age, but at the pre-operational developmental stage have benefited from experiences with handling materials and playing games which involve matching of sets of objects and manipulating objects (Churchill, 1958), one would expect that the older, CA 8-14, mentally retarded child who would also be at the pre-operational stage of development would also profit from these experiences.

The children in the Churchill (1958) program experienced mathematical relationships through the manipulation of objects. This experiencing is similar to the enactive mode of representation present in other investigations. When comparisons were made of the enactive, pictorial and symbolic modes of representation (Bruner, et al., 1966) by administering a test to EMR's, the pictorial and symbolic modes were found easier than the enactive mode (Finley, 1962). These findings, however, have been challenged due to confounding of the types of test administration, individual versus group (Cawley and Goodman, 1967).

The enactive mode of representation for teaching EMR's relations and basic operations were found by Callahan and Jacobson (1967) to build an understanding of concepts in a stepwise, concrete fashion. Cuisinaire rods, the instructional medium used in this program, provided opportunities for the EMR's to explore more advanced mathematics than was usually attempted. Although no data were given to support the finding, Callahan and Jacobson (1967) report that the results achieved were definitely better than might have been achieved in the same time without the cuisinaire rods. It should be noted, however, that actual comparisons with other modes of representation were not made. Inferences about success of the enactive mode over other modes were certainly not confirmed by these reported studies.

A comparison of enactive versus pictorial and symbolic representational codes in an actual instructional program with Trainable Mentally Retarded (TMR) has shown the enactive mode of representation to be superior (Armstrong, 1969*). Pupils in this sample ranged in mental age (MA) from 20 to 56 months with a mean MA of 40 months.

Consequently, one of the questions raised in the current study was: Is mathematical learning of the 9-14 year old EMR affected by the mode of representation utilized in the teaching of mathematical concepts? In order to make comparisons, contrasting programs involving either symbolic or pictorial and symbolic modes of representation were developed. This is described later in great detail (see Manipulative and non-manipulative packet development, p.7).

Another concern in the program development was implementation. There were two basic elements of concern since the program being developed was to be used for experimentation as well as instruction. The first concern dealt with experimental control. If teachers were used as implementors of the program, a great deal of training would have had to precede implementation in order to get the desired result and even then controlling teacher behavior consistently throughout the duration of the experiment would have been very difficult. Consequently, from an experimental point of view using a machine, the implementation character of which remains relatively constant throughout the duration of the experiment, was certainly deemed better.

The question was then raised as to whether or not total learning would be jeopardized by using teaching machines rather than teachers as implementors of the program. The results of some experiments in this area suggested not (Blackman and Capobianco, 1963; Capobianco, 1966). When Blackman and Capobianco (1965) examined the relative effects of machine implementation and traditional teacher implementation on reading and arithmetic learning of mentally retarded adolescents whose average IQ was in the low educable range, no significant differences were found between the two groups except on one arithmetic test. On this test, a specially devised test, the machine implementation group scored better than the traditional teacher implementation group. Capobianco (1966) in a review of the research literature on the use of teaching machine with mentally retarded concluded that when teaching machines were found less superior this result was usually due to: poor quality programs, stereotyped test, or inadequate field testing.

Since programmed instruction utilizing teacher machines as implementors of the program has not been found to jeopardize learning and in some cases has been found to enhance learning and, furthermore, aids in eliminating much of the extraneous variation due to teacher variability, the program was developed to be implemented by teaching machines.

The ideal instructional method to use with the mentally retarded was also not clear from the reported research. Although a vast amount of research has been done contrasting various methods, two of the most consistently researched and theoretically based instructional methods, the expository (deductive)

and discovery (inductive) methods, have been most frequently studied with "normal" pupil samples (Armstrong, 1969; Volume I). One of the more recently reported studies which contrasted these instructional methods using an EMR sample (Armstrong, 1969; Volume II) found no difference between the two approaches on global learning, learning at various cognitive levels or learning within different subject matter areas. These findings, however, have been questioned (Armstrong, 1969) on the basis of length of program, machine failure and lack of marked programming clarity between the two approaches. Consequently, a more thorough examination of these instructional approaches with the retarded with different machines (machines less subject to break-down) and better programming to maximize and emphasize basic differences between the two instructional approaches was suggested (Armstrong, 1969[a]). Thus, a second question raised for investigation: Do inductive and deductive approaches to instruction differentially facilitate the mathematical learning of EMR's?

In order to study this question half of the lesson options were written following an inductive approach and half of the lesson options were written following a deductive instructional approach. This phase of the program development is described in detail later (see Development of Programming Inductive and Deductive Instructional Styles, p. 6).

A third characteristic of programming for the mentally retarded which has been consistently supported verbally, but seldom validated is repetition of presentation. One form of repetition which has been utilized is exact repetition. This form has best been portrayed in the film, "One and Two and Three" (Wexler, n.d.). This film designed for mentally retarded, exactly repeats during the second half of the film what was shown during the first half of the film. Another form of repetition which is utilized quite frequently in mathematics textbooks is the varied form of repetition. In the varied form of repetition, specific problem types are repeatedly presented using different number examples. For example, in order to teach addition of single digit numbers the sums of which are greater than or equal to ten and less than or equal to nineteen, the following sequence of problems would be presented in the varied form of repetition:

1. 5 + 8 = ☐ 2. 7 + 8 = ☐ 3. 7 + 6 = ☐

4. 6 + 5 = ☐ 5. 3 + 9 = ☐ 6. 3 + 9 = ☐

Using the exact form of repetition teaching the same concept the problem sequence would be as follows:

1. 8 × 8 = ☐ 2. 7 × 8 = ☐ 3. 7 × 6 = ☐

4. 8 × 8 = ☐ 5. 7 × 8 = ☐ 6. 7 × 6 = ☐

A recent survey of teachers of the mentally retarded in Wisconsin showed that repetition factors were cited second to skills or content orientation factors as the main strong point of the textbooks these teachers were using in mathematics instruction (Armstrong and Sonnig, In Preparation).

Even though repetition gets frequent support among practitioners, the term is generally not well defined. Whether an exact or varied type of repetition would be better in facilitating the mathematical learning of the mentally retarded is not known. When this question was examined with a small sample of trainable mentally retarded, no global differences were found (Armstrong, 1969[b]). But, when forms of repetition were coupled with modes of representation (manipulative or non-manipulative) certain learning differences were found. The varied form of repetition better facilitated learning when coupled with a manipulative mode, while the exact form of repetition better facilitated learning when coupled with the non-manipulative mode (Armstrong, 1969[b]).

Similarly, when these two forms of repetition were examined with an EMR sample (Armstrong, 1969[b]), no global differences were found between the two forms of repetition, but when coupled with the two forms of instruction, inductive and deductive, differences were found. The exact form of repetition was found to better facilitate mathematical learning at the comprehension and analysis levels when coupled with the inductive form of instruction while the varied form of repetition was found to better facilitate these types of learning when coupled with the deductive form of instruction (Armstrong, 1969[b]). Since the Armstrong (1969[b]) study was plagued by certain limitations due to machine problems, and program construction, these results certainly need validation. Consequently, a third area of investigation was comparison of exact and varied forms of repetition, and exact and varied forms of repetition coupled with inductive and deductive approaches to instruction and manipulative and non-manipulative modes of representation. The program development associated with these two forms of repetition is described in detail later (see Programming Two Forms of Repetition: Exact and Varied, p.7).

Program Development

The present program was devised in part from previously developed programs (Armstrong, 1968; Volume I and II). The general content or topic outline (see Table 1) was an extension and revision of the earlier program outlines. The first program developed for pupils of normal intelligence (Armstrong, 1968; Volume I) consisted of twenty lessons of similar topics, but was implemented by teachers. Consequently, the basic content within topics was written at a higher level and explicit teaching of place value concepts was not included. The second program (Armstrong, 1968; Volume II) designed for EMR incorporated only the first ten lessons, thus, covering only a portion of the content covered in the present program. Even so, most of the scripts of the first ten lessons were rewritten to better maximize differences between the inductive and deductive styles and in order to improve the overall language of the scripts.

After the topics for the twenty lessons were decided upon, program examples were made up for each lesson. The program examples consisted of slide descriptions of what was to be shown to teach each concept within each lesson. Generally, due to the length of the lessons (each 30 minutes in length) only one major concept was taught in each lesson. In general, the slide examples written for the first ten lessons (Armstrong, 1968; Volume II) were used in this program. New examples were devised, however, for lessons 11-20. After designing the slides for each lesson, descriptions of the art work were made up and sent to the artists. The artwork was subsequently photographed and made into 35mm color slides. In total, over 1,000 slides were used in this program (see Appendix I, Master Slide List). The listing in Appendix I gives the identification number and brief description of each slide used in the program.

Programming of Inductive and Deductive Instructional Styles. Scripts were then written in two different instructional styles to accompany the instructional episodes portrayed by the slide examples. The inductive style was characterized by beginning the instructional episode with a problem or puzzle and proceeding with specific examples which exemplified this problem. Questions about each example situation were asked. Pupils were encouraged to draw their own conclusions. The inductive script for lesson One is shown in Appendix II. The numbers in the script refer to slides. Descriptions of the slides by number are given in Appendix I.

The deductive style was characterized by a more "telling" approach. Each instructional episode written in the deductive style began with a statement of the fact, concept or generalization to be taught. Each example was used to further illustrate

and clarify the fact, concept or generalization. The deductive script for lesson one is shown in Appendix II. Again, the numbers in the script refer to the slides which are described in Appendix I.

Manipulative and Non-Manipulative Packet Development. After approximately every two instructional examples in the programmed scripts application activities were introduced. Both manipulative and non-manipulative application packets were designed for each lesson. Packets which occurred at the same point in the instructional sequence were matched in terms of task and concept coverage. The only difference between the two packets was that the manipulative packet was made up of tasks involving the enactive mode of representation while the non-manipulative packets were made up of tasks involving pictorial and symbolic modes of representation exclusive of enactive modes of representation. All of the materials which the pupil would need to complete the application tasks, manipulative or non-manipulative, were placed in large brown envelopes and numbered sequentially for use in each lesson. Directions for completing the task associated with each application packet were included in the lesson scripts (see Lesson One, Appendix II). After completing the task pupils were asked to put the things back into the envelope and place it on the floor. They would then push a button to restart the tape and go on with the instructional sequence. The reinforcement statements following each application task were matched from manipulative to non-manipulative in order to equalize reinforcement effects across program options.

Programming Two Forms of Repetition: Exact and Varied. The exact repetition option was achieved by exactly repeating the first half of the lesson presentation during the second half of the instructional period. The varied form of repetition was achieved by making up new and different examples to teach the same concepts during the second half of the lesson. The exact and varied form of repetition are illustrated in Table 2. A more detailed illustration is given in the actual scripts for Lesson One (see Appendix II).

Editing and Splicing of Slide-Tape-Packet Programs. For each of the twenty lessons (see Table 1), there were eight different instructional-curriculum-media options constructed: 1. Inductive-Exact-Manipulative, 2. Inductive-Exact-Non-manipulative, 3. Inductive-Varied-Manipulative, 4. Inductive-Varied-Non-manipulative, 5. Deductive-Exact-Manipulative, 6. Deductive-Exact-Non-manipulative, 7. Deductive-Varied-Manipulative, 8. Deductive-Varied-Non-manipulative.

TABLE 1

TOPIC OUTLINE OF UNIT LESSONS OF AN ARITHMETIC PROGRAM DEVELOPED FOR ONE PUPIL

LESSON NUMBER	TOPIC
1	Introduction to Data
2	Capability of Data
3	Subset Relations
4	Subset Relations
5	Equivalence Relation (1-1 correspondence)
6	Number Relations (=, ≠)
7	Number Relations (<)
8	Number Relations (>)
9	Number Relations (=, ≠, ≤ , ≥)
10	Set Operations (union)
11	Set Operations (union)
12	Place Value
13	Place Value
14	Place Value
15	Addition
16	Addition
17	Addition
18	Geometry: identification of shapes, square, rectangle, circle, and triangle.
19	Geometry: Between Class congruence-congruence
20	Geometry: Within Class congruence-congruence

TABLE 3

SCRIPT EXCERPTS ILLUSTRATING THE EMATC AND WEBCD FORMS OF GENERATIVE REPETITION

LESSON ONE: INTRODUCTION TO DATA DESCRIPTIVE APPROACH

EMATC FORM	WEBCD FORM
1* We often see *dishes* on a breakfast table. Are these dishes alike in any way? We can see that all the dishes are the same color, but is color the best reason for putting them together in a group? Are the plates, dishes? Are the cups, dishes? Are the bowls, dishes? What is the best reason for putting the plates, the cups, and the bowls together in a group?	1 We often see dishes on a breakfast table. Are these dishes alike in any way? We can see that all the dishes are the same color, but is color the best reason for putting them together in a group? Are the plates, dishes? Are the cups, dishes? Are the bowls, dishes? What is the best reason for putting the plates, the cups, and the bowls together in a group?
2 We often see dishes on a breakfast table. Are these dishes alike in any way? We can see that all the dishes are the same color, but is color the best reason for putting them together in a group? Are the plates, dishes? Are the cups, dishes? Are the bowls, dishes? What is the best reason for putting the plates, the cups, and the bowls together in a group?	20 Here is a group you often see. What are the members of this group? Why are the girls members of this group? Why are the boys members of this group? Are the boys children? Are the girls children? So we put these girls and boys together in a group because they are all children?

*Numbers refer to slides; Number 1 set of dishes; Number 20 set of boys.

The scripts were recorded on audio tape and inaudible signals were programmed into the tapes to signal steps and slide changes. The appropriate slides were loaded into 8-disk Carousel slide trays for each of the eight options for the twenty lessons thus making a total of 160 different instructional episodes. The appropriate packets designed to accompany each instructional episode were packaged with it. The Autotask Teaching Machine was used to implement the program.

Test Development and Evaluation

Since there were no published instruments available for the assessment of mathematical performance of EMR's at various cognitive levels on all of the programs presented concepts, an instrument had to be developed. Although some preliminary work had been done by Armstrong (1968, Volumes I and II) in developing such an instrument, items had not been written to cover all of the concepts which were to be taught in the present program. Therefore, additional items were written to add to the total item pool. Items within the item pool were classified and placed into categories according to cognitive level and lesson number. Then, thirty items were selected for use on the pre-test and sixty items selected for use on the post-test.

Due to the desire to minimize the effects of reading on test performance, the items were recorded on audio tape. Slides were used frequently to minimize verbalism. Both the pre-test and post-test were programmed for use on the teaching machines. Thus, the administration of the test was standard for all subjects.

Pupils answered the questions on Digitek (machine scored) answer sheets. All questions were multiple choice. Individual cards printed with each item were available for the pupils to use so that they could follow along as the test items were read to them. The total post-test is shown in Appendix III. The first 30 items of the post-test were used as the pre-test.

The reliabilities, calculated using the Hoyt (1941) internal consistency procedures, and standard errors of estimate for the pre, post-total and post-cognitive level subtests are shown in Table 3. The reliability of the post-total test was similar to that found by Armstrong (1968; Volume II). A comparison of the reliabilities of the cognitive level subtests for the present test with those reported earlier by Armstrong (1968; Volume II), revealed that the reliabilities of the current subtests were slightly higher.

TABLE I

CRITICAL RATIO VALUES FOR TESTS AND SUBTESTS

Test or Subtest	Number of Items	M	S	Reliability	Standard Error
Post-Total	60	35.44	6.98	.79	± 3.44
Pre-Total	60	28.60	5.96	.86	± 2.60
Post Subtests:					
Knowledge	10	5.80	2.67	.61	± 1.80
Comprehension	10	5.70	2.64	.80	± 1.00
Application	10	6.66	2.77	.69	± 1.10
Analysis	10	5.80	2.62	.60	± 1.06
Synthesis	10	5.90	2.58	.63	± 1.01
Evaluation	10	5.72	2.72	.60	± 1.07

A survey of the post-test item difficulties revealed, however, that many of the items were too difficult (see Table 6). To maximize the overall and, thus, subtest internal consistency reliabilities, the ideal item difficulty should be approximately equal to .50 (Tate, 1955). Items in this test ranged from ten to seventy-five per cent in difficulty.

The average difficulty and discriminatory power of the items within each of the cognitive level subtests were quite similar (see Table 5). Thus, any difference found among cognitive levels of learning could not be attributed to basic item characteristic differences.

In contrast, within content areas there were basic item characteristic differences (see Table 5). The place value and addition items, for example, had much worse item characteristics than the geometry items. When the ten worst items and ten best items on the basis of item characteristics were listed (see Table 6), these differences were even more apparent. The reason the geometry items had better item characteristics than the place value items was due to simplicity and lack of task distraction. For example, items 33 and 51, which are very similar in construction and assessing knowledge of within-class congruence the other between-class congruence, asked in simple statement form a single question and then four picture responses followed. In contrast, the two place value items number 17 and 34, required a regrouping of objects mentally and the identification of a response to work from, thus requiring distraction and translation before response.

A better statement of these items would have been a more direct question with the response options in picture form (see Figure 1). Five separate slides should have been made so that the pupils could see first just the item stem, in this case the illustration of 3 hundreds, 3 tens and 13 units, then, each item response choice, A-D, added one at a time to the total picture, the final slide showing the stem and all four item response choices as shown in Figure 1.

The simultaneous showing of all four item response choices would have substantially improved the overall performance on many of the items. Too often, pupils forgot which response was associated with which letter when they were ready to write down their answer. In items 33, 38, and 47, (see Table 6) for example, when the correct response was the last response shown, more pupils answered the items correctly. In these cases the pupils only had to remember the response for 4 seconds. In cases where the correct response came earlier they may have had to remember the response for as long as 16 seconds. This seems to have made a difference.

TABLE 4

POST-TEST: ITEM DIFFICULTY, DISCRIMINATION, AND CLASSIFICATION

Item	Cognitive Level	Lesson	Difficulty	Discrimination Power
1	ANAL	1	.64	.42
2	KNOW	9	.38	-.14
3	COMP	13	.18	.20
4	APPL	1	.56	.25
5	ANAL	4	.68	.16
6	COMP	5	.19	.27
7	APPL	17	.22	.25
8	KNOW	3	.20	.65
9	APPL	20	.57	.37
10	ANAL	7	.36	.21
11	KNOW	6	.43	.46
12	SYNT	4	.36	.36
13	KNOW	13	.31	.25
14	KNOW	19	.39	.68
15	SYNT	9	.42	.33
16	KNOW	16	.22	.18
17	APPL	15	.13	.03
18	COMP	18	.50	.38
19	ANAL	8	.36	.62
20	APPL	7	.28	.48
21	COMP	4	.19	.29
22	APPL	19	.60	.82
23	ANAL	5	.22	.01
24	COMP	15	.27	.49
25	APPL	6	.67	1.16
26	APPL	5	.51	.76
27	SYNT	8	.28	.61
28	APPL	15	.21	.04
29	ANAL	10	.45	.37
30	SYNT	10	.49	.47
31	KNOW	8	.69	.34

TABLE 4 (Continued)

Item	Cognitive Level	Lesson	Difficulty	Discrimination Power
32	EVAL	1	.40	.51
33	ANAL	2	.38	.24
34	SYN	20	.66	.43
35	ANAL	14	.18	-.03
36	COMP	6	.66	.53
37	EVAL	20	.51	.49
38	SYN	2	.75	.31
39	ANAL	9	.28	.28
40	KNOW	13	.19	.32
41	EVAL	11	.19	.22
42	KNOW	7	.20	.17
43	APPL	11	.42	.03
44	SYN	9	.30	.41
45	APPL	16	.34	.22
46	KNOW	3	.21	-.01
47	KNOW	10	.20	.18
48	KNOW	14	.18	.07
49	EVAL	10	.57	.35
50	EVAL	13	.24	.22
51	KNOW	17	.45	.42
52	COMP	8	.18	-.04
53	COMP	19	.60	.95
54	SYN	17	.22	.07
55	COMP	3	.36	.33
56	SYN	12	.25	-.09
57	KNOW	18	.54	.64
58	COMP	12	.25	.36
59	ANAL	16	.18	-.02
60	COMP	11	.43	.11
61	SYN	14	.28	-.20

TABLE 6

AVERAGE DIFFICULTY AND DISCRIMINATION BY COGNITIVE LEVEL AND LESSON SUBTESTS

Subtest	Mean Item Difficulty	Mean Item Discrimination
Cognitive Levels:		
Knowledge	.50	.32
Comprehension	.42	.38
Application	.45	.44
Analysis	.37	.24
Synthesis	.44	.25
Evaluation	.40	.27
Lessons:		
1 (Intro. to Sets)	.81	.30
2 (Cardinality)	.46	.29
3 (Subsets)	.27	.09
4 (Subsets)	.36	.27
5 (Equivalence)	.26	.21
6 (Number Relations =)	.39	.72
7 (Number Relations <)	.31	.32
8 (Number Relations >)	.64	.09
9 (number Relations < , =)	.29	.16
10 (Set Union)	.64	.00
11 (Set Union)	.35	.09
12 (Place Value)	.33	.23
13 (Place Value)	.19	.26
14 (Place Value)	.21	-.01
15 (Addition)	.28	.26
16 (Addition)	.21	.09
17 (Addition)	.30	.31
18 (Ident. of Shapes)	.36	.40
19 (Between Class Comp.)	.59	.62
20 (Within Class Comp.)	.58	.43

TABLE 6

ITEM CHARACTERISTICS OF TEN OF THE BEST AND TEN OF THE WORST ITEMS

Ten Best Items	Ten Worst Items
32. Which picture shows a pair of shapes that are congruent? A. B. C. D. (Difficulty .60; Discrimination .62)	3. What does this symbol (≠) stand for? A. is equal to B. is not equal to C. is equivalent to D. is greater than (Difficulty .39; Discrimination -.14)
29. Which pair of numbers are not equal to each other? A. 4 & 4 B. 5 & 5 C. 7 & 8 D. 6 & 6 (Difficulty .67; Discrimination 1.16)	17. What is another name for the number represented here( )? A. 3h, 4t, 1u Hun. Ten Unit B. 3h, 3t, 2u xxx xx xxxx C. 3h, 2t, 10u xxxx D. 3h, 4t, 2u xxxx (Difficulty .13; Discrimination .03)
26. Which picture shows two sets which have the same number of members? A. 1 baby, 2 bottles B. 2 children, 4 flowers C. 7 combs, 6 toothbrushes D. 6 fish, 6 fishlines (Difficulty .51; Discrimination .76)	23. These two sets are equivalent sets because combs, rubberbands A. there is a comb for every rubberband and a rubberband for every comb B. there is a comb for every rubberband C. there is a rubberband for every comb D. there are arrows drawn between them (Difficulty .22; Discrimination .01)
22. Why is this group of objects not a set? cat, dish, ball, girl A. a set can only have three members B. the members of this group do not go together C. the members of this group are different colors D. a set does not have any members (Difficulty .49; Discrimination .47)	28. What is the answer to this problem? A. 710 B. 870 C. 880 D. 881 (Difficulty .21; Discrimination .04)

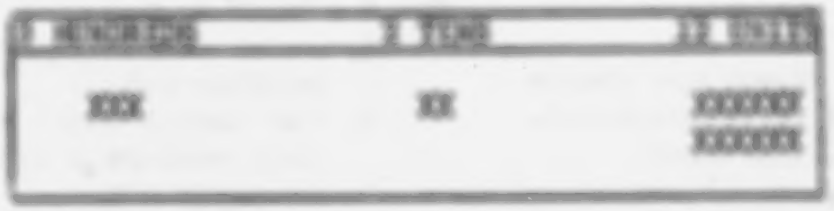
TABLE 6 (Continued)

Ten Best Items	Ten Worst Items
16. Which of the following pairs of numbers are not equal to one another? A. 5, 5 B. 6, 6 C. 8, 8 D. 9, 8 (Difficulty .64; Discrimination .34)	31. Fifty tens is the same as five A. tens & fifty units B. hundreds C. hundred tens D. hundred tens (Difficulty .19; Discrimination -.01)
17. Why are these two shapes (#1149 △ △) congruent. They are the same: A. color B. size C. shape D. size & shape (Difficulty .51; Discrimination .49)	46. A subset is A. a set which is part of another set B. the number which tells how many members a set has C. an empty set D. a set which has the same number of members as any other set (Difficulty .18; Discrimination -.06)
21. Five plus six equals A. eleven (11) B. ten (10) C. seven (7) D. twelve (12) (Difficulty .45; Discrimination .42)	36. A name for this number #346 Hundreds Tens Units xxx xx xxx xxx xxx xxx A. 3 hundreds, 1 tens, 16 units B. 3 hundreds, 3 tens, 3 units C. 3 hundreds, 3 tens, 3 units D. 3 hundreds, 3 tens, 6 units (Difficulty .15; Discrimination -.09)
18. Which picture shows a pair of shapes that are congruent? A. #1309 B. #1308 C. #1310 D. #1306 (Difficulty .60; Discrimination .96)	26. The sum of nine and five is A. 1 ten and 4 units B. 1 tens and 4 units C. 1 tens and 4 units D. 1 tens and 1 units (Difficulty .18; Discrimination -.02)
17. A triangle is a shape with A. four equal sides B. three sides C. no sides D. two pairs of equal sides (Difficulty .54; Discrimination .46)	41. A name for this number is: #372 1 hundred block, 6 ten blocks 3 unit blocks A. 163 C. 163 B. 163 D. 163 (Difficulty .39; Discrimination -.20)

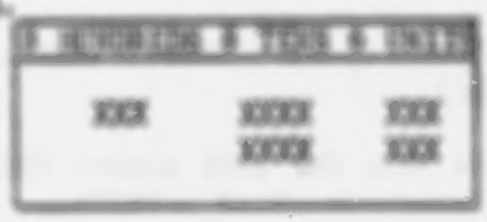
FIGURE 1

REVISED FORMAT FOR PLACE VALUE ITEMS

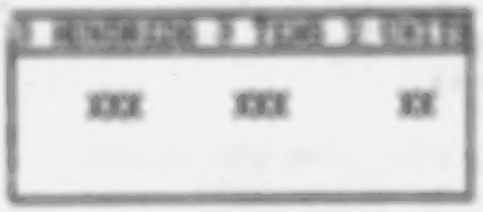
17. Which picture shows the correct way to regroup and rename 3 hundreds 3 tens and 12 units?



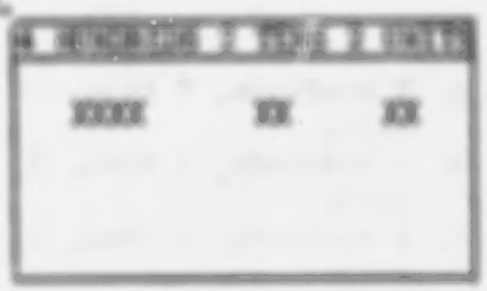
A.



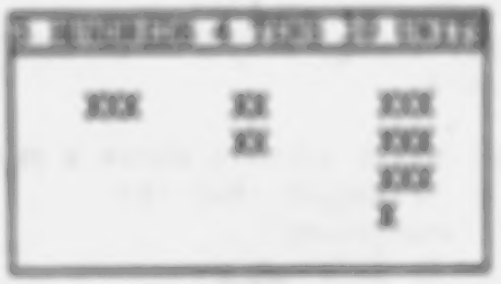
B.



C.



D.



This supports the hypotheses regarding the difficulty EMR pupils have in mentally retaining abstract symbols. Items 17, 28, 35, and 39 (see Table 6) were all characterized by requiring the retention and recall of symbolically stored information. The provision of paper and pencil or small magic slate with time to actually write out the problem and solve it in concrete form would have undoubtedly resulted in improved performance on these items. The addition of illustrations to the stated problem in item 35 would have increased performance without changing the concept being tested and, thus, improved the item.

It was difficult to determine why item 2 was such a poor item. The wording seems simple and straight forward and the response choices did not have to be remembered since they were on the printed item card. The item characteristics indicated, however, that the few pupils who did get the item correct were the pupils who received the lowest scores on the total test.

Item 23 was too subtle and wordy. A simpler stated question assessing knowledge of the same concept would have been:

23. The set of combs and the set of rubberbands are equivalent because they have:
    A. the same numbers.
    B. different numbers of numbers.
    C. the same number of numbers.
    D. different numbers.

Item 46, although quite wordy, would be difficult to change without changing the concept and/or the cognitive level at which this concept was to be evaluated. Perhaps having the printed words for each response on a slide rather than on the card only would have improved overall performance on this item. Item 32 would undoubtedly have been improved by having a single item response slide which showed the four item response choices simultaneously, thus, eliminating the need for retention and recall of item response choices.

Experimental Program

Sample. Seventy-two subjects of chronological age (CA) range of 8 to 15 and mental age (MA) range of 5 to 12 classified as educable mentally retarded were selected for participation from two elementary schools in the Madison Public School System. All pupils within these age ranges from these two schools were included in the sample except those children who had been in the Armstrong (1968; Volume II) program the year before. These subjects were eliminated since much of the material would be repetitious from the previous program and the effects of reten-

tion of concepts from the previous program on learning to the current program would be difficult to evaluate.

The frequencies of subjects per treatment condition cell after loss due to moving, prolonged illness, and truancy were: 1Mh-0, 1Eh-0, 1Eh-0, 2Mh-0, 2Mh-0, 2Eh-0, and 2Eh-0. Since equalizing the cells would necessitate the loss of eleven subjects, least squares unequal cells analyses were done. It was assumed that the results of these analyses would be more accurate.

Procedure. After the subjects were selected for participation they were randomly assigned to one of the eight program conditions. Two instructional mobile units were set up, one at Emerson School and the other at Longfellow School. Comparisons between schools were made on mental age (MA), chronological age (CA), and post-mathematical achievement (see Table 7). Only slight discrepancies were found between the two schools. One school was made up of children of slightly higher CA and MA and, consequently, exhibited slightly higher mathematical achievement. The MA and CA range at Longfellow was greater, but seemingly Emerson pupils had characteristics similar to those of pupils in the lower MA, CA range in the Longfellow sample. Consequently, there seemed to be no reason to expect that the two samples came from different populations. Therefore, for the most part, generalizations were made across school samples.

Similarities on total mathematical achievement, CA and MA, however, did not preclude the possibility of school by treatment interactions. Therefore, to cross-check this possibility, analyses were done, blocking on the school factor.

Autotech teaching machines were used in both rooms to implement both the tests and the 20 lesson instructional programs. Monitors were used to load the teaching machines with the appropriate program option, add new materials to application packets between runs and to be sure the machines and programs were running properly. Monitors were encouraged to aid pupils in understanding tasks or getting objects out of and back into application packets. They were definitely discouraged, however, from stopping the machine and teaching the concept in their own style. This did occur from time to time, however. Hopefully, these instances were randomly distributed over treatment conditions and infrequent.

Although teachers were requested not to teach any other mathematics during the experimental program and agreed prior to the program implementation not to, observations on the part of the monitors proved the contrary. Arithmetic instruction outside the experimental program occurred at only one of the two schools, however, so some cross checks could be made. For the most part the assignments given to the children were pages

TABLE 7

SCORES, COMPARISONS ON MATHEMATICAL ACHIEVEMENT, MENTAL AGE AND CHRONOLOGICAL AGE

SCORES	N	MATHEMATICAL ACHIEVEMENT		MENTAL AGE		CHRONOLOGICAL AGE	
		$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Longitudinal	39	22.69	7.32	142.77	16.96	142.77	16.96
Cross-sec	28	21.96	5.32	93.86	8.52	120.46	12.48
	67						

of addition, multiplication, subtraction and division problems. Since subtraction, multiplication, and division were not covered in the experimental program the effects on work in the experimental program would be in the addition area.

Undoubtedly, the approaches were quite different. The experimental program focused on an understanding of addition through emphasis on numeral quantity association and place value. The teacher oriented textbook approach focused on recall of specific facts through repetition of the facts by working pages of problems out of the textbook. The arithmetic taught by the teachers probably did not aid the pupils in answering most of the questions on the experimental test. Since drill facilitates recall rather than understanding (Brownell and Chazal, 1935), only four items in the addition portion of the test could have possibly been affected by this extraneous instruction. These items required only recall of specific facts.

There were nine addition items on the post-test; items numbers 7, 13, 16, 26, 28, 45, 51, 54, and 59 (see Appendix III). Five of these items required comprehension, synthesis, or analysis level performance (see items 13, 16, 26, 54, and 59; see Appendix III). Performance on these items was probably unaffected by the drill and memorization practice in the classroom. Four of the items, however, were knowledge or application level items which may have been affected by drill and memorization practice in the classroom (see items 7, 28, 45, 51; Appendix III).

In order to examine the question of whether or not extra-experimental drill did have an overall effect on learning, the scores of the two schools were compared on these four items as well as globally (see Table 8). When total scores on the post-test were examined, no substantial differences were apparent. Later analyses revealed that there were no significant differences between the two schools on total learning (see Results and Discussion section, p.47).

In terms of individual item performance, however, the Longfellow group performed somewhat better on items 28 and 51 (see Table 8). On items 7 and 45, however, the scores were very similar. The greatest difference was on the basic fact item 51. This item required recall of the basic fact 8 + 6 = 14. It would be difficult to verify completely that this better performance was directly attributable to extra-experimental drill. It may have been due, for example, to pre-experimental knowledge as well.

Since pupils were randomly assigned to treatment conditions, the effects of this added practice were assumed to be evenly distributed across the various program options. The number of subjects in each treatment combination by school is shown in Table 9.

TABLE 9

GENERAL COMPARISONS: CLAIMED AND ON AUDITION STORE

DESCRIPTION	SHERMAN (N=29)		WINCHESTER
	X	X adj	X (N=89)
Pre-Total			
Post-Total	91.96		95.99
CR	230.66		241.77
RR	93.66		99.75
7 Regrouping of units only	.11		.10
10* Regrouping of units only	.96		.77
60 Regrouping of units and tens	.79		.91
61* Basic Part (5 + 6 + 7)	.06		.98

TABLE 9

NUMBER OF SUBJECTS IN EACH
TREATMENT CONDITION FROM THE TWO SCHOOLS

Treatment Combination	Number of Students	
	[illegible]	[illegible]
[illegible]	6	3
[illegible]	6	3
[illegible]	5	3
[illegible]	6	3
[illegible]	4	4
[illegible]	3	4
[illegible]	4	4
[illegible]	1	4

A pre (prior to instruction) test of thirty items (see Appendix III) was administered to all of the pupils by using the teaching machine and programmed directions. Pupils answered on machine scored answer sheets. The pre-test was completed in two 20 minute sessions. After completing the pre-test, pupils took one lesson per day, approximately 30 minutes in length, of the mathematics program. After completing the twenty lesson program, a post-test of 61 programmed items was administered (see Appendix III). The first thirty items of the post-test were the same as the pre-test. Test and item statistics were previously shown and discussed (see Test Development and Evaluation section, p.19).

Program Evaluation

To evaluate the relative success of the "Mr. Mathematics Program" in promoting DMR learning globally, at various cognitive levels and in different mathematical areas, pupil performance across all eight treatment options was examined. The relative power of the Mr. Mathematics Program in influencing DMR mathematical learning was investigated by examining several specific questions:

1. Did the Mr. Mathematics Program produce total mathematical learning?
2. Did the Mr. Mathematics Program produce mathematical learning at all cognitive levels?
3. Did the Mr. Mathematics Program produce mathematical learning in all specified areas of mathematics?
4. Did the Mr. Mathematics Program differentially promote mathematical learning for different mental age groups?
5. Did the Mr. Mathematics Program differentially promote mathematical learning for different chronological age groups?
6. Were some lessons of the Mr. Mathematics Program better than others in producing mathematical learning?

Procedures for Program Evaluation. To answer question one, two statistical tests were computed, a t test for means of correlated samples on the pre-test scores and the post-test scores adjusted for item number by dividing by two, and a grand mean test on post-total mathematical achievement scores with pre-mathematical achievement as a covariate. All data analyses were done by computer using the Finn Version IV Program (Finn, 1968). To answer question two and three, multivariate analyses of covariance grand mean tests were computed and the appropriate overall F ratios calculated and evaluated for significance at the .05 level. When overall F ratios were found to be significant, univariate analyses and standardized discriminant function coefficients were examined for each of the subtests.

To answer questions four and five, univariate analyses on post-mathematical achievement with pre-mathematical achievement as a covariate and multivariate analyses of covariance on mathematical area and cognitive level subtests with pre-mathematical subtests as covariates were computed on mental age and chronological age factors. The appropriate F ratios were computed and evaluated for significance at the .05 level. Again, when overall multivariate F's were found to be significant, univariate analyses and standardized discriminant function coefficients were examined for the individual subtests. To answer question six, a multivariate analysis of covariance was computed for the grand mean with post-mathematical by lesson subtests as the variates and pre-total mathematical achievement as the covariate. Univariate analyses and standardized discriminate function coefficients for all by lesson subtests were also examined.

Results of Program Evaluation

Question One: Total Mathematical Learning. The results of the t test for means for correlated samples and the grand mean test on post-mathematical achievement adjusted for pre-mathematical achievement are shown in Table 10. Upon evaluation, both the t and F were found to be significant at or beyond the .001 level. It was concluded then, that the Mr. Mathematics Program did produce total mathematical learning for the Educable Mentally Retarded Pupils involved in this study.

Question Two: Mathematical Learning at Six Cognitive Levels. The results of the multivariate analysis of covariance on mathematical learning at six cognitive levels are shown in Table 10. The results indicate that the Mr. Mathematics Program did produce different amounts of learning at the various cognitive levels, (see Overall F ratio; Table 10), but yet produced learning at each cognitive level (see Univariate F ratios; Table 10). Mathematical learning was the greatest at the synthesis level. Synthesis level learning required the putting together of specific elements and parts so as to form a whole; it required the forming of a generalization. Mathematical learning at the comprehension, application, and analysis levels was quite similar (see SDF coefficients; Table 10). Seemingly, the least amount of learning took place at the knowledge and evaluation levels. The knowledge level required direct recall of specific facts. The evaluation level required judgments about the concepts and generalizations learned.

Question Three: Mathematical Learning in Specified Mathematical Areas. The results of the multivariate grand mean test on mathematical learning in specified areas of mathematics indicated that different amounts of learning took place in

TABLE 10

MATHEMATICAL ACHIEVEMENT ACROSS PROGRAM OPTIONS GRAND MEAN TESTS

Variate	Covariate(s)	Mean Square	F	Degrees of Freedom	p ≤	SDF Coefficient
Post-Total/T	Pre-Total	387.93	1=3.39	46	.001	
Post-Total	Pre-Total		19.18	1,90	.0001	
Post-Cognitive Levels	Pre-Cognitive Levels	Overall	3.91	6,69	.0027	
Knowledge		10.67	4.09	1,63	.0491	=.1716
Comprehension		26.55	10.05	1,65	.0020	=.3230
Application		13.72	6.67	1,65	.0165	=.2507
Analysis		12.67	5.79	1,65	.0262	=.2327
Synthesis		30.62	12.96	1,65	.0006	=.4509
Evaluation		12.60	4.57	1,65	.0362	.0984
Post-Mathematical Areas	Pre-Mathematical Areas	Overall	6.20	6,69	.0002	
Sets		21.14	7.94	1,65	.0078	.0760
Relations		64.38	23.69	1,65	.0010	=.6205
Union		12.65	7.21	1,65	.0132	=.6693
Place Value		26.41	15.65	1,65	.0003	=.7046
Addition		7.67	3.94	1,65	.0664	=.0650
Geometry		21.71	4.90	1,65	.0326	.0650

the different areas (see Overall F ratio; Table 10), but mathematical learning did take place in all six specified areas of mathematics (see Univariate F ratios; Table 10). The standardized discriminant function coefficients associated with the six subtests indicated that more learning took place in the relations, union and place value areas than in the sets, addition and geometry areas. Relations, place value and union were undoubtedly new areas of study for the mentally retarded. In general, mathematics programs used with the mentally retarded do not include explicit instruction in these areas.

Question Four: Differential Learning with Respect to Mental Age. The results of the multivariate and univariate on mental age are shown in Table 11. When total mathematical learning was considered, learning differences were found to be dependent upon the mental age level of the pupils involved. As would be expected, children in the high mental age group exhibited higher mathematical achievement than the middle mental age group; and likewise, the middle mental age group exhibited higher mathematical achievement than the low mental age group (see Table 12).

Mental age groups performed similarly at each of the six cognitive levels and within each of the six specified mathematics areas (see Table 11). Since differences were not found on performance at specific cognitive levels and within particular mathematical areas when three mental age groups were compared, the mental age group performance pattern would be assumed to be relatively uniform and consistent.

Question Five: Differential Learning with Respect to Chronological Age. To examine question five, subjects within the study were ranked according to chronological age and placed in three groups, high, middle and low chronological age. Univariate and multivariate analyses of covariance were then computed on the chronological age factor.

The results of these analyses are shown in Table 13. No differences in mathematical learning were found with respect to chronological age. Therefore, it was concluded that the "Mr. Mathematics Program" equally promoted mathematical learning globally, at different cognitive levels, and in the specified mathematical areas for the three chronological age levels studied.

Question Six: By Lesson Analysis. The results of the multivariate and univariate analyses of covariance on post-mathematical, by lesson subtests is shown in Table 14 . The results of these analyses indicated that the Mr. Mathematics Program did vary in its promotion of mathematical learning from lesson to lesson. Some lessons were better than others in promoting mathematical learning.

TABLE 11

SUMMARY OF UNIVARIATE AND MULTIVARIATE ANALYSES
ON NEUTRAL AGE FACTOR

Variate(s)	Covariate	Mean Square	F	d.f.	p ≤
Post-Total	Pre-Total	116.09	3.73	3,42	.0324
Cognitive Level	Pre-Total	Overall	1.00	12,74	.4624
Mathematical Area Subtests	Pre-Total	Overall	1.36	12,74	.2782

TABLE 10

ADJUSTED MEANS ON MATHEMATICAL ACHIEVEMENT
FOR THREE MENTAL AGE LEVELS

Variate	Covariate	Mental Age Level		
		High	Middle	Low
Post-Total	Pre-Total	24.30	22.24	20.49

TABLE 10

SUMMARY OF MULTIVARIATE AND UNIVARIATE ANALYSES OF COVARIANCE ON THE CHRONOLOGICAL AGE FACTOR

Variate(s)	Covariate(s)	Mean Square	F	Degrees of Freedom	p =
Post-Total	Pre-Total	62.97	2.14	2,42	.1301
Post-Cognitive Levels	Pre-Total	Overall	1.13	12,74	.3525
Post-Mathematical Areas	Pre-Total	Overall	1.01	12,74	.4454

TABLE 24

SUMMARY OF MULTIVARIATE AND UNIVARIATE ANALYSES OF VARIANCE
ON POST BY LESION DISTRICTS WITH PRE-TOTAL AS [illegible]

Source of Variation	Mean Square	F	Degrees of Freedom	P ≤	Std Coefficient
Grand Mean		4.00	20.01	.0000	
Lesion 1	1.0910	1.01	1.00	.1610	-.0110
Lesion 2	1.0360	1.01	1.00	.0999	.0822
Lesion 3	1.9709	1.16	1.00	.0276	.7809
Lesion 4	0.0004	0.01	1.00	.9156	-.6691
Lesion 5	1.0960	4.16	1.00	.0666	.3360
Lesion 6	0.0001	0.19	1.00	.6721	.0769
Lesion 7	0.0600	1.07	1.00	.3000	.3106
Lesion 8	0.8320	0.36	1.00	.5506	-.0209
Lesion 9	2.6726	4.00	1.00	.0616	.2799
Lesion 10	1.6065	6.07	1.00	.0135	.3666
Lesion 11	1.7866	6.78	1.00	.0122	.3637
Lesion 12	1.0209	3.14	1.00	.0825	.0760
Lesion 13	1.0966	1.66	1.00	.1091	-.0637
Lesion 14	7.1369	15.87	1.00	.0000	.6781
Lesion 15	1.0727	1.24	1.00	.1610	.1234
Lesion 16	0.9276	1.24	1.00	.1606	.1520
Lesion 17	0.0065	0.00	1.00	.9292	-.6020
Lesion 18	0.6720	1.66	1.00	.0649	.1099
Lesion 19	0.3092	0.48	1.00	.3166	-.5637
Lesion 20	1.1110	1.00	1.00	.0719	.0926

A plot of the standardized discriminant function coefficients associated with each lesson is shown in Figure 2.

The variance between lesson 3 and 4 was in part due to the type of items used to reflect each lesson. The objectives reflected in the chosen lesson 3 subtest items were knowledge (requiring recall of subset definition), and comprehension (requiring identification of a set and use of its subsets) level items. The objectives reflected in the chosen lesson 4 items were application (identification of a set which could not be a subset of a given set), analysis (identification of elements which could not be members of a subset of a given set) and synthesis (identification of the original set of a given subset) level items.

Even so, the lessons themselves were designed to teach the same concepts, so the reflection of differences between lessons was the difference between presentation (wherein designated lesson 3 concepts were taught) and application (wherein lesson 4 concepts were taught) program sections of the two lessons combined.

The most obvious problem with the application tasks (reflected by lesson 4 designation) was the incorrectness of one of the answer slides associated with one set of the application packets. Pupils were shown a set of bleep, a blip, and blip (see Figure 3). They were asked to draw on the answer sheet all of the possible subsets of the set of a bleep, a blip, and a blip. The answer slide shown was incorrect (see Figure 3). The correct answer slide is also shown in Figure 3.

One of the other application tasks was equally as confusing to the pupils due to the lack of clarity in the correct answer. In fact, on this particular application task, none of the pupils got it correct. Pupils were given a work sheet with a set of animals: a cow, a pig and a horse (see Figure 4). Pupils were given six different colored crayons and asked to circle all of the different subsets. This worked fine for the first two subsets, but was disasterous thereafter due to the confusion of lines (see Figure 5).

Two other application examples used in the subset lessons are shown in Figure 6 and 7. Pupils were asked to identify specified subsets of the given set (e.g. subset of those dominoes whose dots on both sides sum to four).

The referent in this case was too broad and complicated and thus, the task was not successfully completed by the majority of the students.

Figure 3

By Lesson Plot of

Standardised Discriminant Function

Coefficients

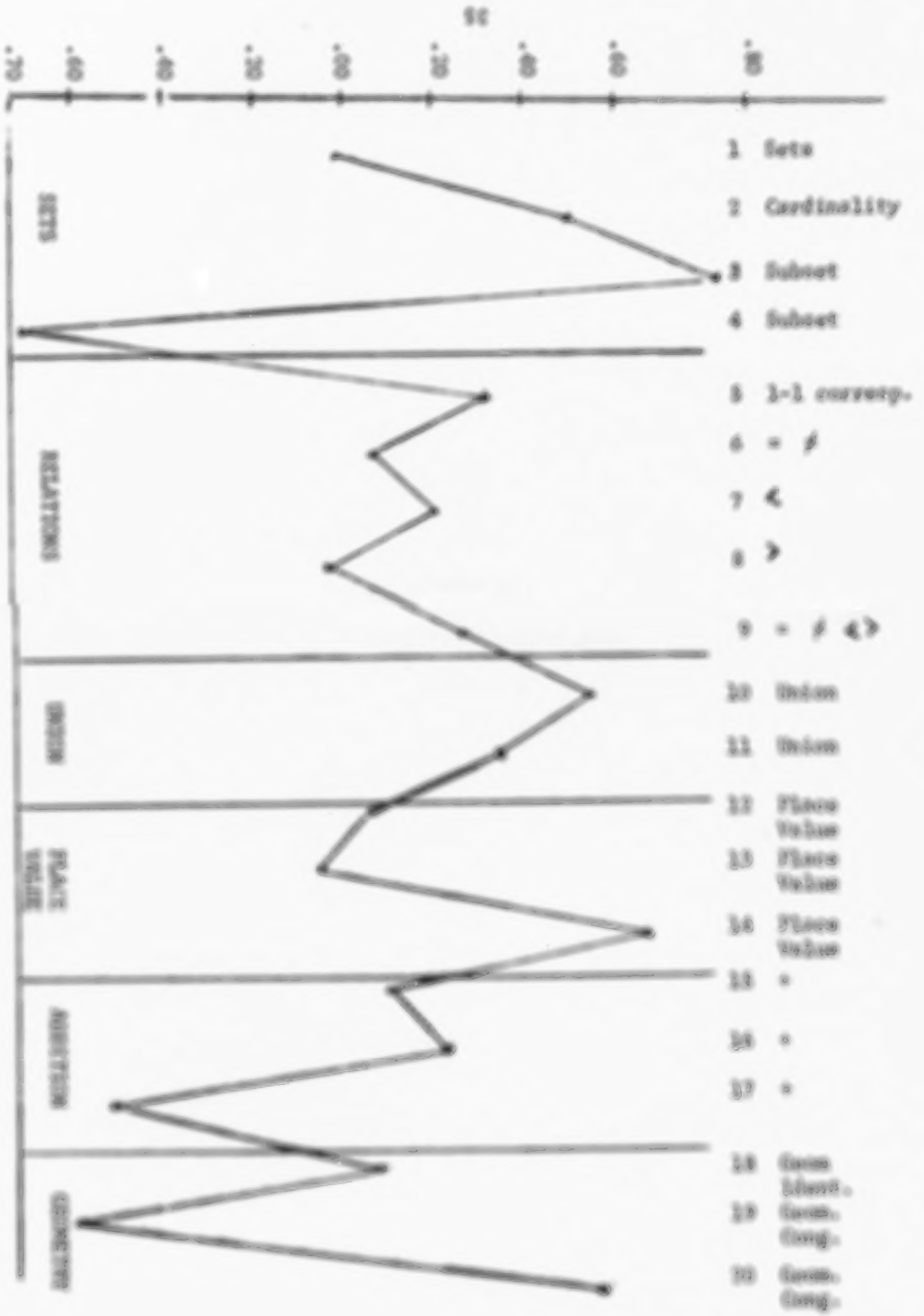
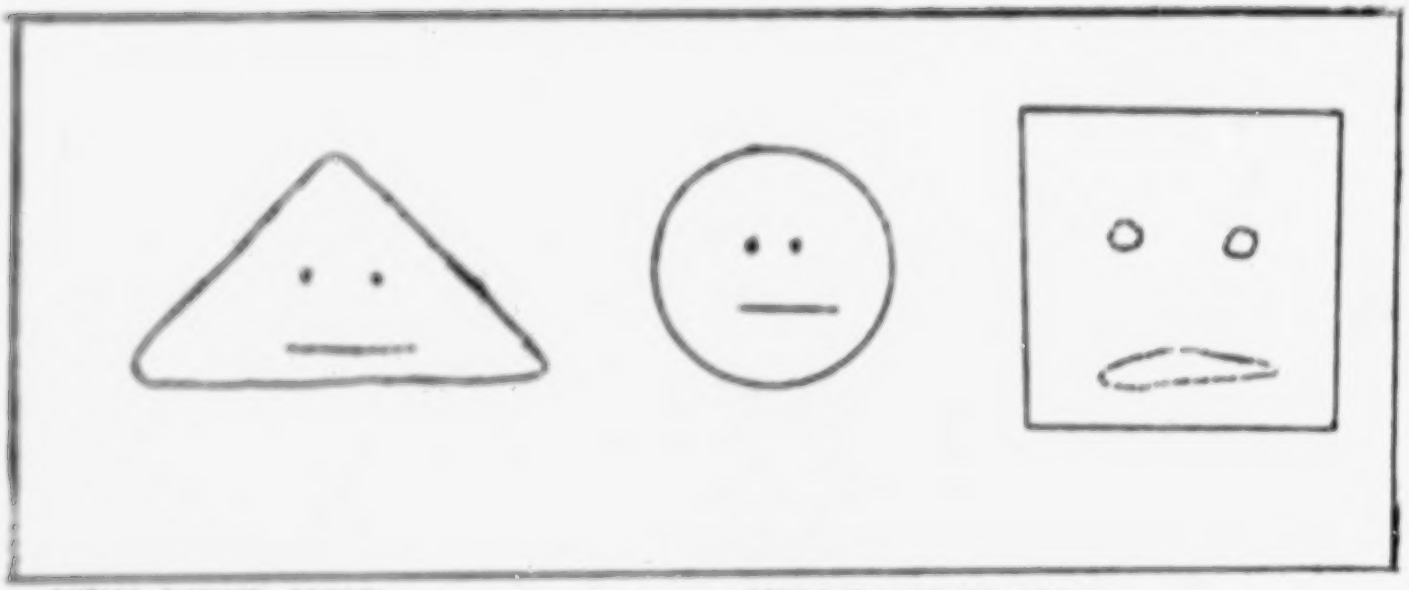

1 Sets
2 Cardinality
3 Subset
4 Subset
5 1-1 corresp.
6 = ∅
7 ∈
8 ⊃
9 = ∅ ∈⊃
10 Union
11 Union
12 Power Value
13 Power Value
14 Power Value
15 ∘
16 ∘
17 ∘
18 Comm. Diagram
19 Comm. Diagram
20 Comm. Diagram
SETS
RELATIONS
FUNCTIONS
ORDER
POWER SETS
ASSOCIATIVE
COMMUTATIVE

Figure 8

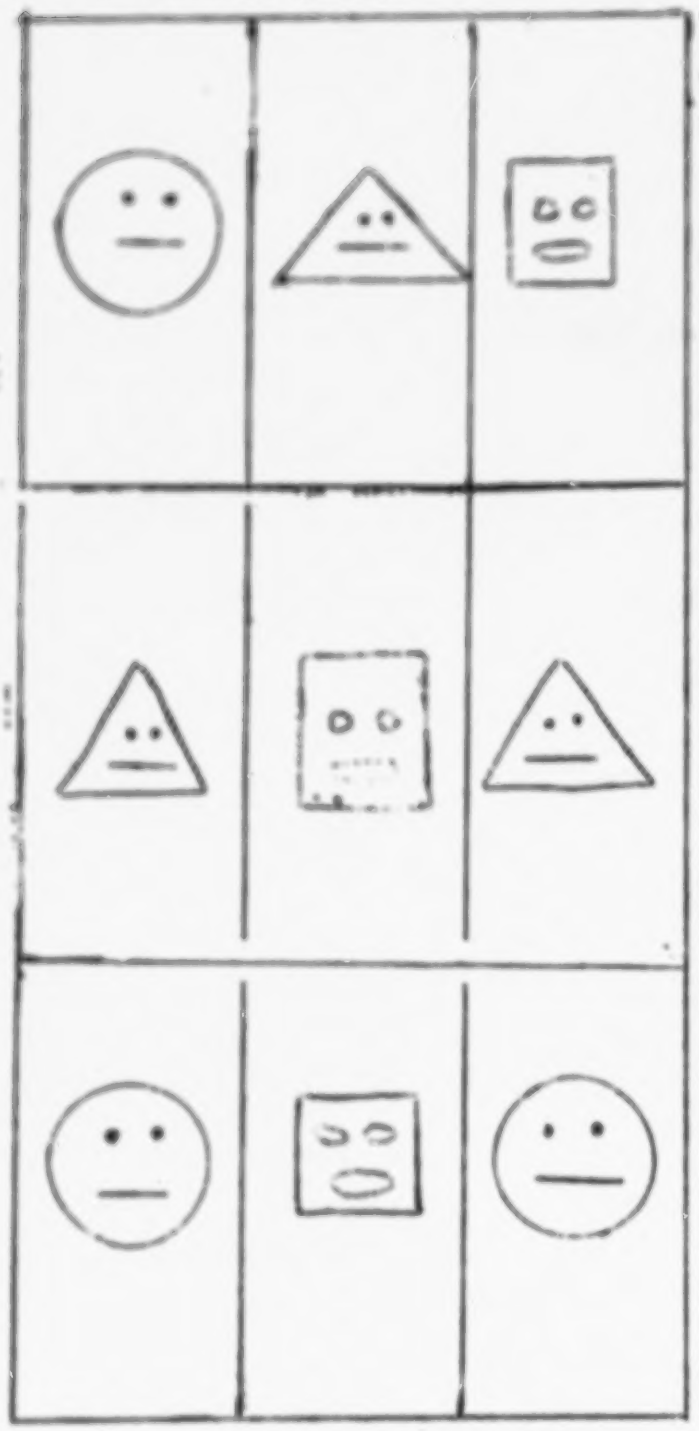
Subset Application Task

Number 013

ORIGINAL SET 013



SHOWN ANSWER SLIDE



CORRECT ANSWER SLIDE

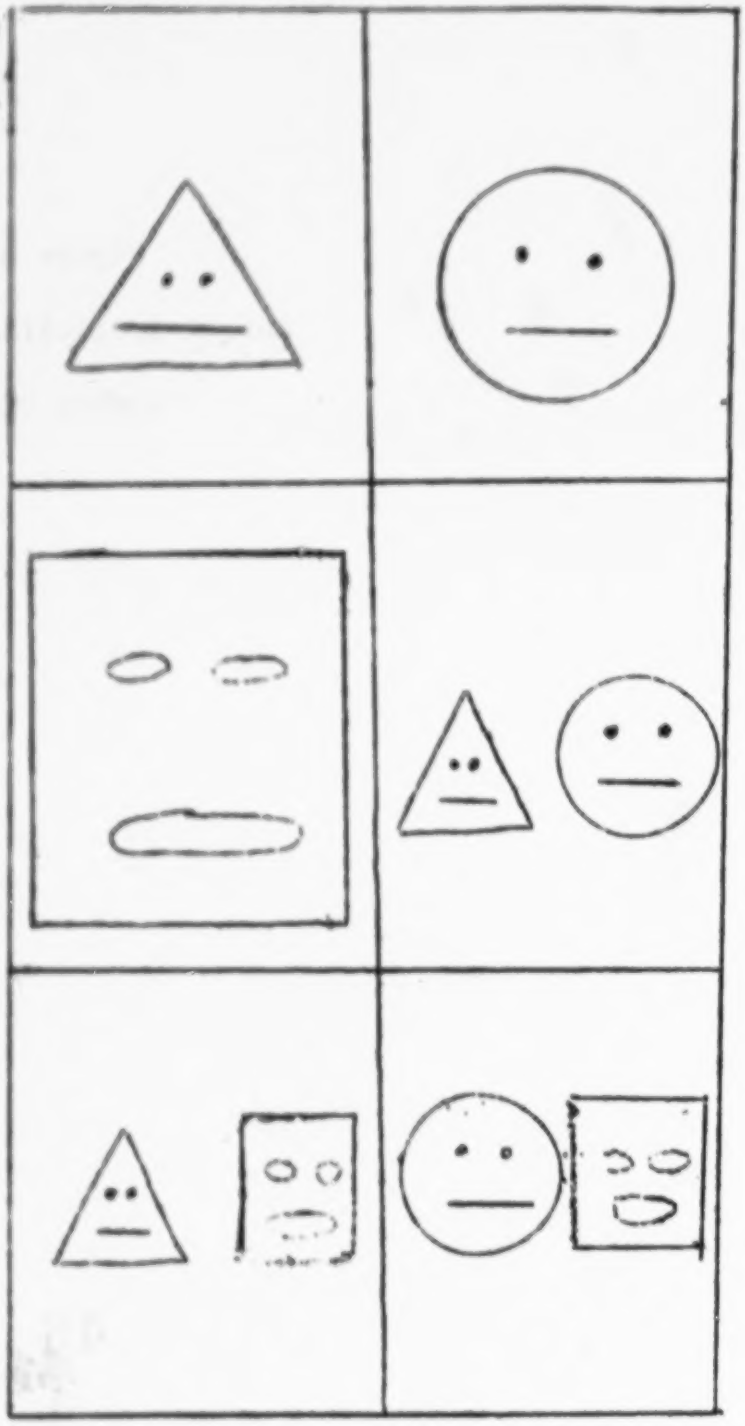
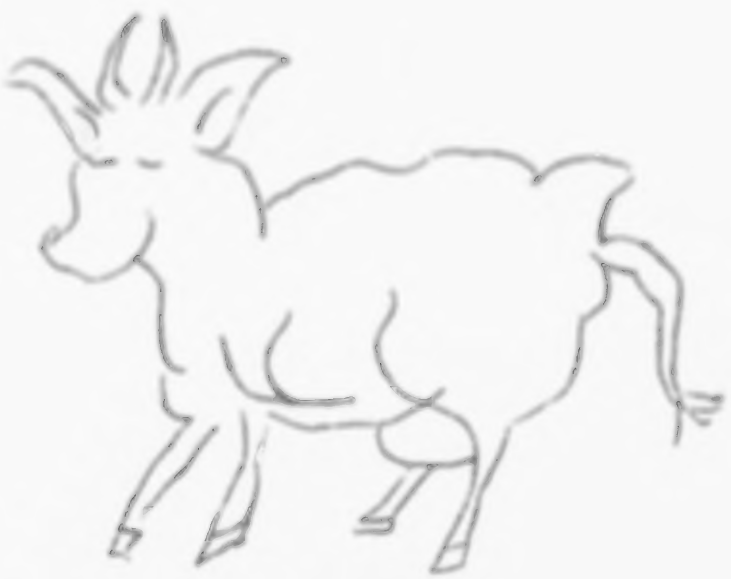


Figure 4

Subset Application Task

Number 015



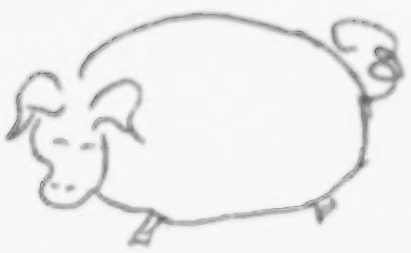


Figure 5

Completed Subset Application Task [1]

Number 015

[1]Different types of lines are substituted for color differentiation. The effects are still obvious.

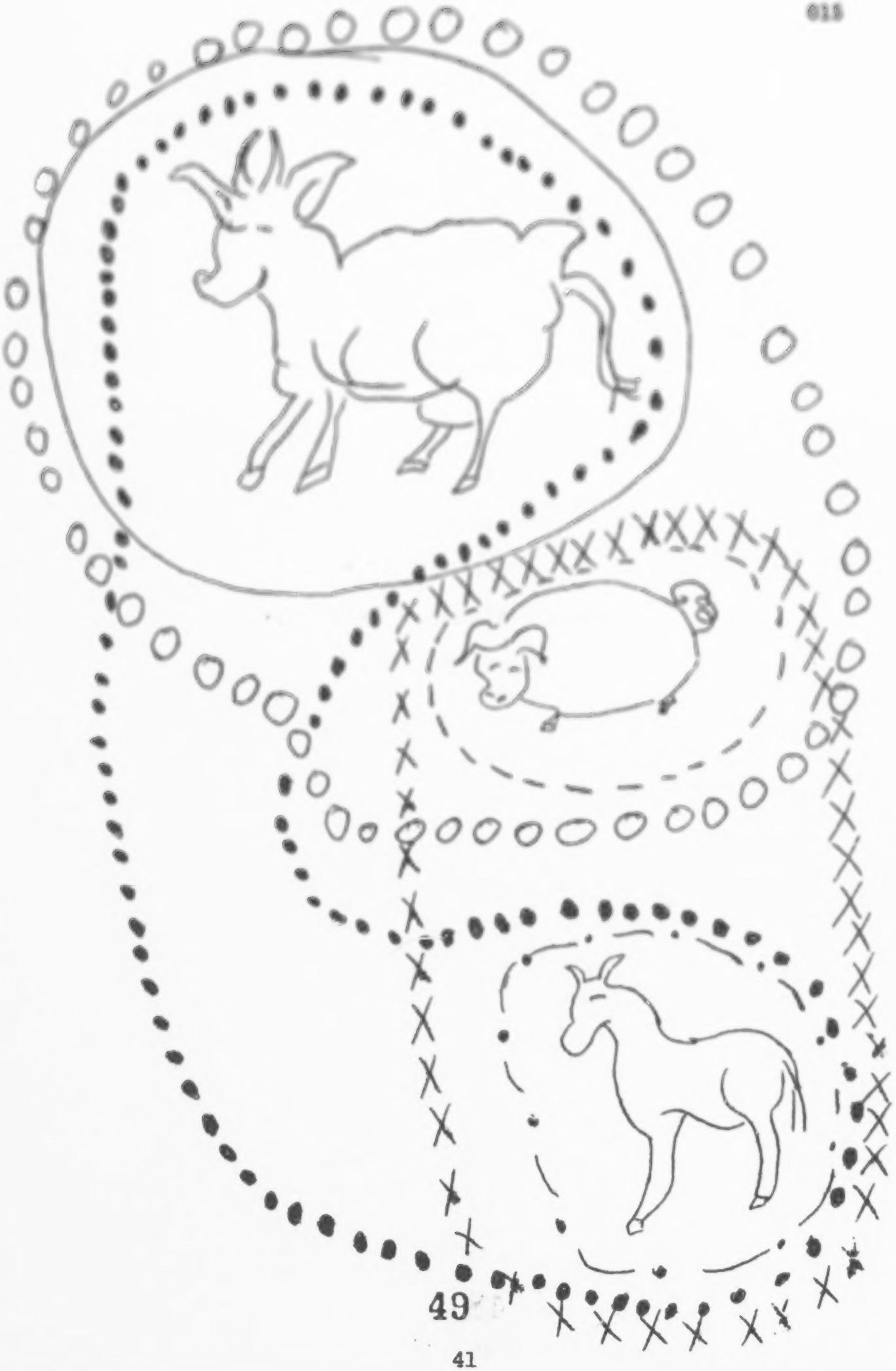
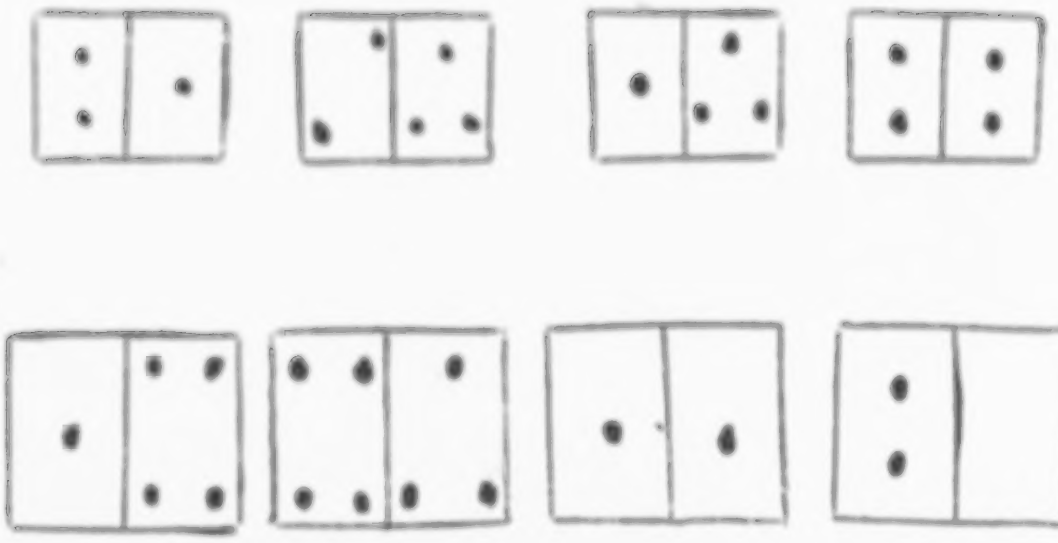
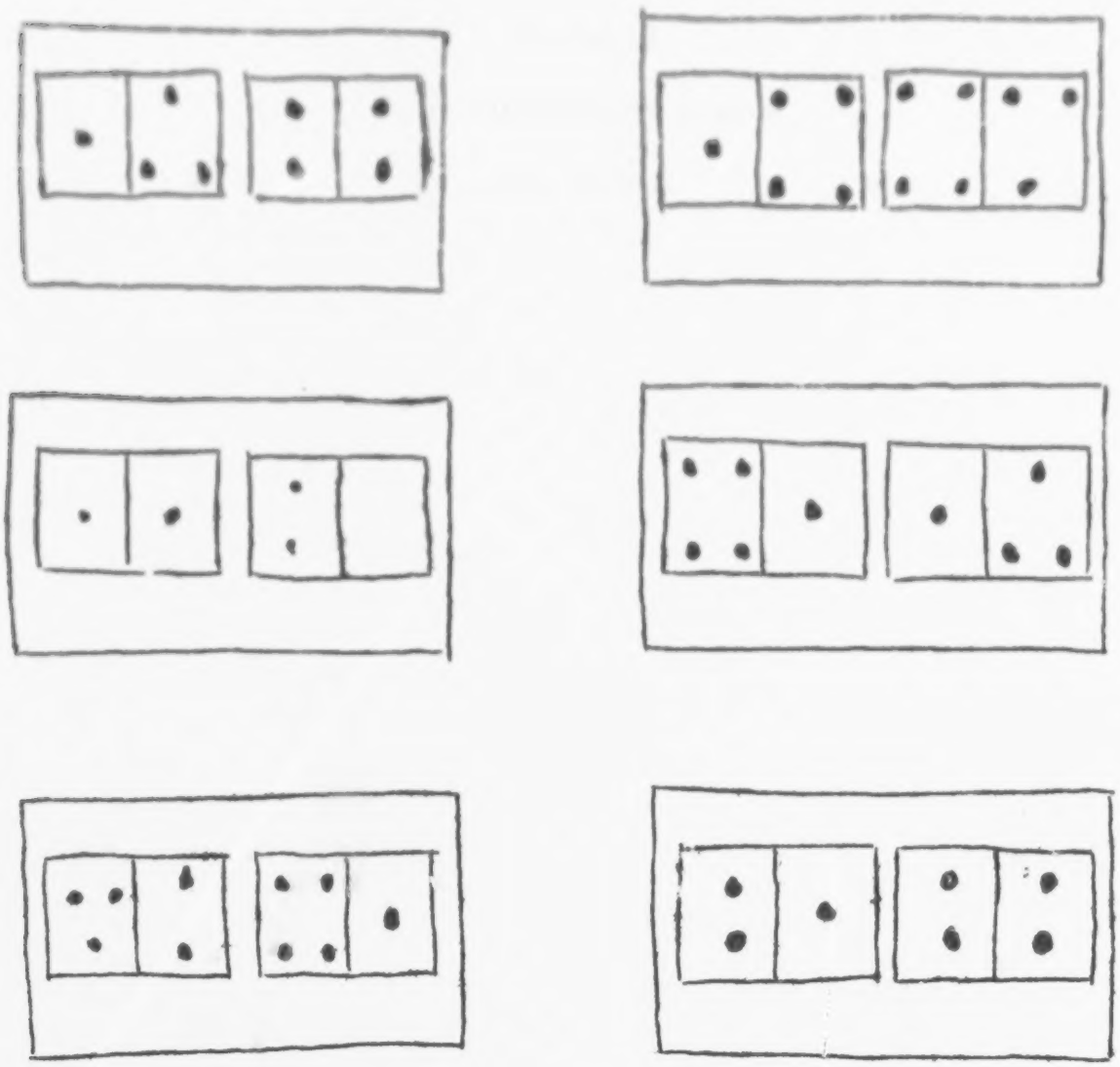


Figure 6

Subset Application Task

Number 209



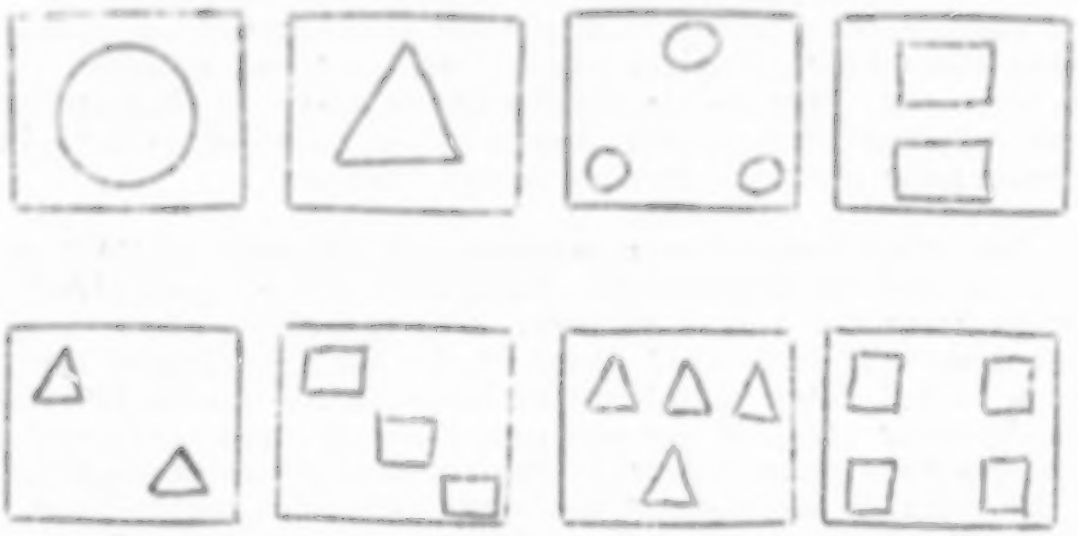


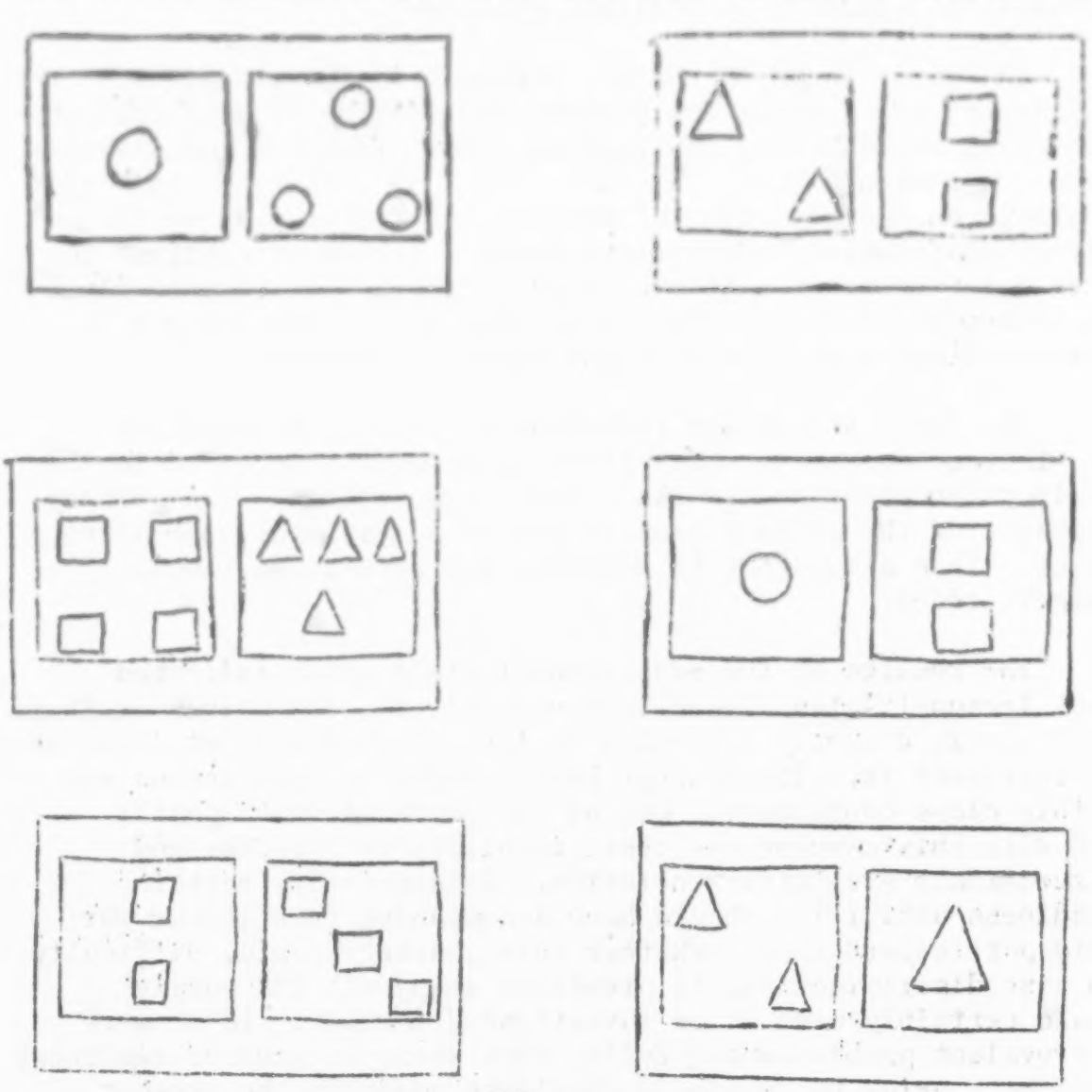
51

Figure 7

Subset Application Task

Number 211





These problems in programming undoubtedly led to the subset learning problems associated with items used to identify lesson 4. The concepts which the pupils were successful on were associated with the presentation or instructional phase rather than the application phase which in these lessons was very poor. The success reflected on lesson 3 (due to the items selected to represent lesson 3) can be attributed to the instructional phase of the two subset lessons.

Two other lessons were reflected in the data analysis as being in need of improvement: Lessons 17 and 19 (see Figure 2). Subtest items for lesson 17 were: 51, 7, and 54. In comparing these lesson 17 items with Items 24, 28 and 13 selected for lesson 15 and Items 16, 59 and 45 selected for lesson 16 subtest (see Appendix III), it was apparent that the items selected to represent lessons 15 and 16 focused more on comprehension of the addition process and how place value (regrouping and renaming) was utilized in the addition process while the items selected to represent lesson 17 focused primarily on straight application (solving of addition problems).

The major focus of the Mr. Mathematics Program was to supplement the typical EMR mathematics program of application and drill on addition, subtraction, multiplication and division with new content areas, geometry, sets and relations with major emphasis on understanding of mathematics rather than on the direct application of memorized facts. It was of interest to note here, however, that the programs pupils had been involved in before had no more effect than they did on attaining a correct final answer on straight addition problems.

The implications for revisions in the Mr. Mathematics Problem are apparent. More practice should be provided in the application packets in working addition problems. The primary emphasis of the present packets was an understanding of place value. This should not be removed, but rather additional packets added.

The results of the experimental field trial indicated that lesson 19 also needed improvement. The objectives of this lesson were directly reflected in the selected subtest items used to represent it. The concept being taught in this lesson was within class congruence. One of the problems which pupils had with this concept was their inability to perceive and discriminate size differentiation. Consequently, certain readiness activities should have accompanied this lesson for this particular group. Whether this characteristic, difficulty in size discrimination, is prevalent among all EMR pupils would certainly need to be investigated further. If it were a prevalent problem among EMR's, then steps to provide readiness material prior to lesson 19 should be added to the present Mr. Mathematics Program.

Results and Discussion

The purpose of the experimental phase of this study was to develop a series of EMR mathematics programs which differed on three major dimensions, repetition, instruction and mode, and to assess the influence of these curricular and instructional factors in affecting mathematical learning globally, at each of six cognitive levels, and in different areas of mathematics. Extraneous factors such as IQ, MA, CA, and school were also examined in relation to the curricula-media variables and learning.

Experimental Design. A 2x2x2 completely crossed randomized block design was utilized with unequal numbers of replicates per cell. The four factors, instruction (I) with two levels, inductive and deductive, repetition (R) with two levels, exact and varied, and mode (M) with two levels, manipulative and non-manipulative, and school (S) with two levels, Emerson and Longfellow, were all considered to be fixed rather than random. Therefore, the within cell mean square was used as the error term. The .10 level of significance was set as acceptable.

Statistical Analysis. Univariate analysis of covariance procedures were utilized to analyze the total score data and multivariate analysis of covariance procedures were utilized to analyze the cognitive level and subject area subtest data. All data analyses were done on computer using the Finn Verision IV Program (Finn, 1968). When overall multivariate tests were found to be significant, univariate tests and standardized discriminant function coefficients were utilized to locate the specific sources of variation contributing to or causing this overall difference. Directions of differences were inferred from the adjusted means.

Total Mathematical Learning. The results of the univariate analysis of covariance on total mathematical achievement with IQ and pre-mathematical achievement as covariates are shown in Table 15. When IQ and pre-mathematical achievement were used as covariates, the effects found to be significant at the .10 level were regression, instruction by repetition (IR) and repetition by mode (RM) (see Table 15).

The repetition factor although strongly supported verbally by the practitioner has gained little support experimentally (see Table 10). Consistently, (Armstrong, 1968, Volume II; Armstrong, 1969) this factor has not been found to be significant.

TABLE 15

SUMMARY OF UNIVARIATE ANALYSIS OF COVARIANCE ON TOTAL MATHEMATICAL ACHIEVEMENT WITH IQ AND PRE-MATHEMATICAL ACHIEVEMENT AS COVARIATES

Source of Variation	Mean Square	Degrees of Freedom Hypothesis	Degrees of Freedom Error	F	p ≤
Regression		2	49	11.65	.0001
IQ		1	49	8.59	.0051
Pre-Total		1	48	12.71	.0009
Instruction (I)	48.27	1	49	1.66	.2032
Repetition (R)	72.49	1	49	2.50	.1205
Mode (M)	18.88	1	49	.65	.4238
School (S)	20.35	1	49	.70	.4065
IR	151.51	1	49	5.22	.0267
IM	30.54	1	49	1.05	.3100
IS	9.91	1	49	.34	.5618
RM	84.55	1	49	2.91	.0942
RS	.88	1	49	.03	.8623
MS	12.47	1	49	.43	.5152
IRM	4.51	1	49	.16	.6951
IRS	.36	1	49	.01	.9114
IMS	33.57	1	49	1.16	.2874
RMS	72.62	1	49	2.50	.1201
IRMS	3.42	1	49	.12	.7328
Within (Cell)	29.02		49		

Mode was not found to significantly affect total mathematical learning. The results of an earlier study, however, (Armstrong, 1969), showed that mode was a critical factor in the learning of numeral-quantity associations by the TMR. The differences in the findings between the two studies are probably attributable to either of two factors, (1) mental age differences between the two samples or (2) mathematical content differences between the two programs used.

The mental age range of the pupil sample in this study was 5 years 8 months to 11 years 9 months while the mental age range of the TMR study (Armstrong, 1969) was 2 years 4 months to 4 years 8 months. Certainly, the interaction of mental age and mode of representation should be explored as a reasonable possibility. Seemingly, if mental age accounts for this difference the mental age range of 2 years 4 months to 5 years 8 months should be carefully scrutinized. An exploration of mode by mental age interaction effects in the range of 5 years 8 months to 11 years 9 months revealed no significant differences[1].

The instruction by repetition factor was found to be significant (see Table 15). The inductive approach was found to form a better combination with the varied form of repetition while the deductive approach was slightly better when coupled with the exact form of repetition (see Table 16).

The IR factor was not found to be significant in the Armstrong (1968; VolumeII) study. Again, this lack of significance may have been due to the length of the program (i.e., ten lessons as compared to twenty), the differences in mathematical content, and/or programming or machine problems in the previous study. Seemingly, when using a more telling approach exactly repeating the presentation does enhance the learning, but when using a more inductive or discovery-type approach a variety of examples enhances learning.

The repetition by mode factor was also found to be significant at the .10 level (see Table 15). The means indicated that the manipulative mode combined with the varied form of repetition and the non-manipulative mode combined with the exact form of repetition resulted in greater overall learning than did the other two repetition and mode combinations (see Table 17). This result is the same as one found by Armstrong (1969[c]) with trainable mentally retarded.

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[1](Mental Age by Mode Interaction Effect Mean Square = .99, $F=.03$, $= p \leq .9692$).

TABLE 14

ORIGINAL MEANS AND MEANS ADJUSTED FOR PRE-ACHIEVEMENT, ACHIEVEMENT AND IQ ON POST-MATHEMATICS ACHIEVEMENT FOR INSTRUCTION AND ASPIRATION COMBINATIONS (A=47)

Instruction & Aspiration Combination	Means		Raw Regression Coefficients	
	Original	Adjusted	Pre-Achievement	IQ
Instruction-Count	51.19	50.80		
Instruction-Wanted	56.65	55.71	.69	.58
Instruction-Count	51.80	51.90		
Instruction-Wanted	59.66	61.60		

[illegible]

[illegible]

[illegible]	[illegible]		[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	.08	.10
[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]		

Seemingly, the abstract nature of non-manipulative materials is compensated somewhat by the exact repetition of the presentation. In contrast, the concrete nature of the manipulative materials provides enough learning momentum to make it possible for the pupils to experience a change in presentation without learning loss. This conclusion must also presuppose that the exact form of repetition jeopardizes learning when manipulatives are involved and the varied form of repetition jeopardizes learning when non-manipulative materials are involved. Seemingly, there is an underlying cognitive development scheme in operation. Maturity coming too soon in the cognitive process development and exact repetition coming when the developmental process is complete can be a hindrance to learning.

Mathematical learning at the cognitive levels. When mathematical learning was examined at the cognitive levels in terms of the various treatment combinations, the results varied somewhat for the main factor, depending upon the choice of covariates (see Tables 10 and 12). Consistently, no significant differences were found on all other factors.

When pre-cognitive level subtests were used as covariates, mode was found to be significant at the .10 level (see Table 10). An examination of the univariate tests by subtest and the standardized discriminant function coefficients associated with the two analyses (see Table 11) indicated that this overall difference was concentrated primarily at the synthesis level of learning. An examination of the adjusted means indicated that the manipulative mode was better than the non-manipulative mode in facilitating synthesis level learning (see Table 11).

Although when IQ was added as a covariate the mode factor on the overall multivariate F test was no longer significant (see Table 12), the results of the univariate test for synthesis level learning differences were more pronounced (see Table 13). Mathematical learning at the synthesis level for the mode factor on the univariate test when IQ was used as a covariate was significant at the .0080 level (see Table 13). The standardized discriminant function coefficient associated with synthesis level learning was also large in both cases. Again, an examination of the means (see Table 11) when adjusted for IQ indicated that the manipulative mode better facilitated mathematical learning at the synthesis level than did the non-manipulative mode.

Mathematical learning in different forms. Instruction (I), Instruction by Exposition (IE), and Instruction by Mode by Intent (IMI) were all found to differentially effect the mathematical learning of sets, relations, set union, place value, addition and geometry (see Table 11).

TABLE 10

SUMMARY OF MULTIVARIATE ANALYSIS OF COVARIANCE ON POST-
COGNITIVE LEVEL SUBTESTS WITH PRE-COGNITIVE
LEVELS SUBTESTS AS COVARIATES

Source of Variation	Degrees of Freedom Hypothesis	Error	F	P<
Regression	10	170	3.04	.0002
Pre-knowledge	1	61	.41	.8170
Pre-comprehension	1	66	3.06	.0012
Pre-application	1	61	3.20	.0134
Pre-analysis	1	63	.01	.9303
Pre-synthesis	1	62	.77	.3967
Pre-evaluation	1	63	.10	.7266
Grand Mean	1	63	8.41	.0037
Instruction (I)	1	63	.09	.9110
Repetition (R)	1	63	.31	.8776
Mode (M)	1	63	3.91	.0990
Schema (S)	1	63	2.31	.1335
IR	1	63	1.36	.2617
IM	1	63	3.66	.0760
IS	1	63	.09	.7629
RM	1	63	2.19	.0760
RS	1	63	.61	.6135
MS	1	63	.10	.6671
IRM	1	63	.99	.3777
IRS	1	63	.61	.6480
IMS	1	63	2.11	.0747
RMS	1	63	2.69	.0301
IRMS	1	63	.67	.6713
Within (Cell)		63		

TABLE 11

DIMENSION OF MULTIVARIATE ANALYSIS OF COVARIANCE ON
POST-CONNECTIVE LEVELS WITH PRE-CONNECTIVE
LEVEL, DIMENSIONS AND DF AS COVARIATES

Source of Variation	Degrees of Freedom Hypothesis	Error	F	P <
Regression	45	1240	0.10	.9997
Pre-Semantic	5	621	.83	.8278
Pre-Comprehension	5	608	1.05	.8955
Pre-Application	5	615	0.98	.8146
Pre-Analysis	5	612	.93	.8965
Pre-Synthesis	5	611	.77	.9467
Pre-Evaluation	5	603	.68	.7304
II	5	591	1.06	.9938
Error Term	5	591	.59	.7093
Interaction (I)	5	591	.84	.8124
Aspiration (A)	5	591	.76	.8598
Male (M)	5	591	1.07	.1111
School (S)	5	591	.90	.8865
IA	5	591	1.05	.8998
IM	5	591	1.10	.9479
IS	5	591	.78	.8934
AM	5	591	1.09	.9457
AS	5	591	.89	.8744
MS	5	591	.82	.9889
IAM	5	591	.77	.9451
IAS	5	591	.93	.9555
IMS	5	591	1.06	.8888
AMS	5	591	1.03	.3551
IAMS	5	591	.89	.3966

TABLE 10

SUMMARY OF UNIVARIATE ANALYSIS OF VARIANCE ON COGNITIVE LEVEL SUBTESTS FOR THE MEDIA FACTOR

Subtest	Mean Square	F	P≤	SSE Coefficients
Pre-Cognitive Level Subtests as Covariates				
Knowledge	.60	.17	.6844	.1263
Comprehension	.56	.15	.6619	.1011
Application	.03	.19	.6277	.1670
Analysis	1.19	.00	.6960	-.1076
Synthesis	10.61	8.63	.0027	-1.0714
Evaluation	.01	.01	.9199	.0215
Pre-Cognitive Level Subtests and IQ as Covariates				
Knowledge	.01	.01	.9151	.0160
Comprehension	.00	.01	.9424	.1240
Application	.16	.08	.7819	.0169
Analysis	.01	.11	.8476	-.0696
Synthesis	11.11	9.16	.0035	-1.0967
Evaluation	.15	.09	.7623	.0317

TABLE 15

ADJUSTED MEANS ON MATHEMATICAL LEARNING AT VARIOUS COGNITIVE LEVELS FOR TWO MODES

Cognitive Level	Mode	
	Non-Manipulative	Manipulative
	Adjusted for Pre-Achievement	
Knowledge	3.87	3.83
Comprehension	3.72	3.79
Application	3.93	4.37
Analysis	3.68	3.57
Synthesis	4.09	3.81
Evaluation	3.69	3.61
	Adjusted for IQ and Pre-Achievement	
Knowledge	3.96	3.90
Comprehension	3.78	3.72
Application	3.98	4.30
Analysis	3.97	3.80
Synthesis	4.08	3.59
Evaluation	3.78	3.66

TABLE 11

[illegible]

[illegible]	[illegible]			
	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The univariate analysis on each of the six content area subtests for the instruction factor is shown in Table 15. The content measured with the meaning of sets seemed to be the area most affected by the instructional approach used. An examination of the means and standardized discriminant function coefficients (see Table 16) indicated that the inductive approach was better than the deductive approach in teaching set union. This finding complements an earlier finding with a normal sample (Armstrong, 1968; Volume I). The inductive approach was found to better facilitate the learning of operations. These included set union as well as other set and number operations.

The interaction by repetition (IR) factor was also found to be significant (see Table 15). The IR factor when examined by individual subtest analyses and standardized discriminant function coefficients (see Table 16) seemed to primarily affect learning in the areas of relations, set union, and place value. The affected areas within these areas indicated that the directions of the effects were consistent with that found for total learning (see Table 14). The inductive approach was better coupled with the mental form of repetition and the deductive approach was better coupled with the exact form of repetition and the use of these two combinations was significantly better than the inductive coupled with exact and the deductive coupled with mental forms of repetition (see Table 14).

The interaction by mode by school factor was also found to be significant on the overall multivariate test (see Table 15). The interaction of instruction and mode with school was most probably reflecting an interaction of instructional mode and content with mental age rather than any real school factor. An examination of the univariate tests and standardized discriminant function coefficients (see Table 17) indicated that the learning of number relations was the primary area affected. In the learning of relations, consistently Emerson pupils did better under the deductive-manipulative combination than under the other three combinations (see Table 14; Figure 6). Longfellow pupils did better under the deductive-manipulative and inductive-nonmanipulative combination than under the other two combinations.

TABLE 10

SUMMARY OF HIERARCHICAL ANALYSIS OF SIMULTANEOUS IN PRE-AREA DIRECTS FOR THE SOUTHEASTERN CANTON WITH PRE-AREA DIRECTS AS COVARIATES

Source of Variation	Sums Squares	F	p	SSE Coefficients
Constant				
Curbs	.00	.00	.0000	-.0000
Subdivisions	0.00	1.00	.0000	.0000
Distance	10.10	0.70	.0000	1.1187
Street Values	.00	.00	.0000	.0000
Additions	.00	.00	.0000	-.0000
Connectivity	.10	.00	.0000	-.0000

TABLE 10

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

TABLE 10

SUMMARY OF UNIVARIATE ANALYSIS OF PIED-AREA
SUBJECTS FOR 10 FACTOR WITH PIED-AREA
SUBJECTS AS COVARIATES

Source of Variation	Mean Square	F	p≤	COF Coefficients
Instruction & Repetition				
Sets	.00	.00	.9900	.0021
Deletion	10.70	2.65	.1200	-.7262
Set Index	6.06	3.69	.0680	-.0367
Place Value	6.69	5.27	.0227	-.6006
Addition	5.00	3.67	.1091	-.2351
Geometry	2.61	.59	.6669	.1358

TABLE 24

ADJUSTED POST-AREA SUBTEST MEANS
FOR THE 2X FACTOR

Post-Area Subtests	Combinations of Instruction and Repetition			
	1-2	1-7	2-2	2-7
Sets	4.69	5.10	4.66	5.13
Relations	4.69	6.15	5.07	5.11
Set Union	2.60	3.23	2.21	3.04
Place Value	1.75	2.15	2.44	3.40
Addition	2.04	2.55	2.68	3.09
Geometry	4.15	5.24	5.06	5.05

Source of Variation	Mean Square	F	p %	OLS Coefficients
Instruction by Mode by School				
Data	5.54	2.05	.1549	-.0553
Relations	11.40	4.51	.0090	1.1340
Set Union	4.49	1.90	.1240	.1090
Place Value	2.53	1.43	.2390	.0010
Addition	.06	.03	.0010	-.0039
Geometry	.67	.11	.7466	-.1766

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			2nd Treatment Conditions					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Corn	6.22	6.70	9.70	5.00	5.60	6.76	6.60	6.60
Soybeans	3.66	3.60	6.60	6.56	6.37	7.62	6.35	6.20
Soil Index	3.70	3.26	3.62	3.20	3.56	3.69	3.66	3.61
Plant Value	3.97	3.20	3.67	3.66	3.66	3.90	3.62	3.99
Addition	3.96	3.67	3.67	3.60	3.63	3.60	3.67	3.64
Geometry	6.71	6.79	3.66	6.92	5.66	5.76	6.76	6.66

Figure 6

Instruction, Mode, and Subject Combinations as they Influence the Learning of Number Relations

Summary and Conclusions

The objectives of this study were: 1) to develop a mathematics curriculum of programmed instruction for EMR's and to evaluate the effectiveness in facilitating global learning, learning at various cognitive levels, and learning in different areas, 2) to develop an evaluative instrument which would reliably assess mathematical learning at global, at various cognitive and with different mathematical areas, and 3) to determine the relative effects of two instructional approaches (inductive and deductive), two forms of repetition (exact and varied) and modes of representation (manipulative and non-manipulative) on the mathematical learning of a selected sample of pupils classified as educable mentally retarded (EMR) of CA range 9-13.

Program Development and Evaluation. Such seemed to be gained on the addition of application packets to the overall program. The involvement of the pupils in an applied task seems to be essential in keeping attention and making the presented mathematical concepts more concrete. Pupils were quite motivated by the enveloped tasks and looked forward to them during the instructional sequence. Certainly, a fruitful avenue of exploration in program development would be the determination of the profitable balance between such task involvement and formal presentation.

The total program when it was allowed to vary resulted in significant amounts of learning globally at various cognitive levels and in different mathematical areas. The program was most successful with the higher range MA group, and less successful with the middle and lower range MA groups respectively, seemingly the mental age range for which this program was best designed was the 8-11 year MA range. This result, however, may be due to the difficulty levels of the test rather than explicit learning difficulties of the lower MA range pupil with this particular program.

Several suggestions for revision and addition are apparent as a result of the field trial. In general, the suggested revisions and additions were: 1) for more application tasks dealing with addition practice, 2) converting obvious answer slide screen, 3) simplification of the skills involved in application task completion and 4) provision of certain reinforcement materials or subprograms on also discrimination tasks.

Another revision which would aid in individual lesson evaluation would be the programming of the by lesson subtest items as part of the lesson packet. This would facilitate interpretation by equalizing length of recall.

Test Development. One of the more difficult aspects of the test development is the construction of easy items. The development of the present test was a case in point. Many of the items were too difficult. This occured sometimes from a technical base, inability of the pupils to view all four item response choices simultaneously, sometimes from a wording problem and other times from the unnecessary requirement of mental retention of symbols. Undoubtedly, if these aspects of the test were changed, the test would be improved.

Experimental Phase. Mathematical learning was differentially promoted for these 280's as a function of certain curricular and instructional factors depending upon what mathematical area they were studying and the cognitive level at which they were required to respond.

The manipulative mode of application better facilitated synthesis level learning than did the non-manipulative mode of application. The inductive mode of presentation better facilitated the learning of set operations than did the deductive mode of presentation. The two forms of repetition, exact and varied, equally facilitated all types and levels of mathematical learning.

The inductive mode of instruction combined with the varied form of repetition was better on global learning and the learning of relations and set union than the other instructional mode and repetition form combinations. The deductive mode of instruction was better coupled with an exact form of repetition. The varied form of repetition better promoted learning when combined with a manipulative mode of application. The non-manipulative mode of application was found to better combine with the exact form of repetition.

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[illegible]

[illegible]

Slide Number	Description
1	Mr. Mathematics with basket of numbers, basket of sets, and basket of shapes
2	set of dishes
2g	set of 8 dishes
3	set of golf clubs
3g	set of golf clubs
4	empty set
5	baby
6	set of swings
7	one of swings
8	set of swings / one of swings
9	set of pets
9g	pets
10	dog
11	cat
12	bird
13	set of pets / dog
14	set of pets / cat
15	set of pets / bird
16	set of fruit
17	apple
18	orange
19	banana
20	grapes
21	set of fruit / apple
22	set of fruit / orange
23	set of fruit / banana
24	set of fruit / grapes
25	set of five boys with different shirts
26	boy with white shirt
27	boy with purple shirt
28	set of five boys / boy with white shirt
29	set of five boys / boy with purple shirt
30	set of six balloons
31	blue balloon
32	set of balloons / yellow balloon
33	set of seven books on table
33g	set of 7 books on table
34	red book
35	green book
36	set of books / red book
37	set of books / green book
38	set of coins
39	nickel
40	dime
41	set of eight coins / nickel
42	set of coins / dime
43	set of nine pencils

(cont.)

Slide Number	Description
56	blue pencil
57	set of pencils / blue pencil
58	set of ten balls
59	one ball
60	set of balls / one ball
61	light cues: green light - yes; yellow light - maybe; red light - I don't know
62	one of swings / light cues
63	baby / light cues
64	Mr. Mathematics frowning (perturbed)
65	Mr. Mathematics smiling (overjoyed)
66	Mr. Mathematics (befuddled)
67	swing / set of pets
68	baby / set of books
69	cat / fruit
70	nickel / pencils
71	cat / light cues
72	cat / set of horses
73	baby / 1
74	set of chairs
75	set of chairs / 2
76	set of pets / 3
77	set of pine trees
78	set of pine trees / 4
79	set of boys / 5
80	set of six footballs
80g	set of six footballs
81	set of footballs / 6
82	set of coins / 8
83	set of airplanes
84	set of airplanes / 7
85	set of umbrellas
86	set of umbrellas / 9
87	(not assigned)
88	set of balls / 10
89	set of pie
90	set of pie / 1
91	two pieces of pie
92	two pieces of pie / 2
93	three birds
94	three birds / 3
95	four cars
96	four cars / 4
97	set of watches
98	set of watches / 5
99	set of hands
100	set of hands / 6
101	set of glasses of milk

(cont.)

Slide Number	Description
90	set of glasses of milk / 7
91	set of train cars
92	set of train cars / 8
93	set of fish
94	set of fish / 9
95	set of candy
96	set of candy / 10
97	empty set
98	empty set / 0
99	set of footballs / green light - yes; yellow light - no; red light - I don't know
100	light cues: green light - 5; yellow light - 2; red light - 3
101	set of swings / 2
102	group of objects - cat, dishes, ball, girl
102a	group of objects - cat, dishes, ball, girl
103	light cues: green light - 4; yellow light - 6; red light - 5
104	light cues: green light - 9; yellow light - 10; red light - 8
105	light cues: green light - 7; yellow light - 8; red light - 6
106	5 blocks on a green sheet of paper, 5 dishes on a red sheet of paper, and 5 coins on a yellow sheet of paper
107	ditto 101, 5 blocks colored green, 5 dishes colored red, 5 pieces of money colored yellow
108	3 puppets / 6 cardboard animals
109	ditto 102, 3 puppets colored blue, 5 animals colored yellow
110	3 plastic men on one sheet of white paper, 3 blocks on another white sheet, and 3 cars on a third sheet
111	ditto 103, 3 blocks marked in red with the letter A, 3 dolls marked with red circles, and 3 cars with red X's
112	6 stones on a red paper, 5 buttons on a blue paper, and 3 candles on a yellow paper
113	ditto 104, 6 blue stones, 5 red buttons, 3 yellow candles
114	3 spoons on a red sheet of paper, 5 sticks on a green sheet
115	ditto 105, 3 spoons colored red, 5 sticks colored green
116	on three separate sheets of white paper: 5 crayons, 3 pieces of fruit, 4 jacks
117	ditto 106, 3 pieces of fruit with letter a on them, 4 crayons marked with A, and 5 jacks each with an O on it
118	sheet of white paper with word SUBSETS in bottom half, in top half 2 squares, one with a green and one a yellow block
119	sheet of white paper with word SUBSETS in bottom half, in top half 2 squares, one with a blip, the other a blop

(cont.)

Slide Number	Description
030	cook, eat, spoon
031	set of eight children (five boys and three girls)
032	children / boys
033	set of three girls
034	children / girls
035	set of six balloons (four red, two green)
036	red balloons
037	green balloons
038	yellow balloons
039	6 balloons / red balloons
040	6 balloons / green balloons
041	6 balloons / yellow balloons
042	dog and cat
043	set of pets / dog and cat
044	set of six hands and three feet
045	set of three feet
046	set of hands and feet / hand
047	set of hands and feet / feet
048	set of pots and pans
049	yellow sauce pan and blue sauce pan
040	two frypans
041	two yellow pans
042	two blue pans
042y	one blue pan
043	set of socks
044	short socks
045	long socks
046	red socks
047	set of socks / short socks
048	set of socks / long socks
049	set of socks / red socks
050	set of clothes
051	set of blouses
052	set of skirts
053	set of clothes / blouses
054	set of clothes / skirts
055	set of red clothing
056	set of clothes / red clothing
057	set of one boy / set of pets
058	set of one boy / light cues: green light = yes; yellow light = no; red light = I don't know
059	yellow balloons / light cues: green light = yes; yellow light = no; red light = I don't know
060	yellow sauce pan
061	two red skirts
062	one red blouse
063	not assigned
064	not assigned

(cont.)

Slide Number	Description
165	not assigned
166	not assigned
167	not assigned
168	not assigned
169	not assigned
170	not assigned
171	not assigned
172	not assigned
173	not assigned
174	not assigned
175	not assigned
176	not assigned
177	not assigned
178	not assigned
179	not assigned
180	not assigned
181	map of United States
182	picture of California
183	United States with California outlined / California
184	picture of United States with California outlined
185	Missouri
186	picture of United States with Missouri outlined
187	picture of United States with Missouri outlined / Missouri
188	picture of Wisconsin
189	picture of United States with Wisconsin outlined
190	picture of United States with Wisconsin outlined / Wisconsin
191	set of two large plates
192	set of dishes / two large plates
193	set of two large plates and two small plates
194	set of dishes / two large plates and two small plates
195	one small, two large, and one small plate
196	one small, two large, and one small plate / two
197	one small, two large, and one small plate / set of dishes
198	set of children (two tall boys, one short boy, one tall girl, and two short girls)
199	set of boys
200	set of children / boys
201	set of girls
202	set of children / girls
203	set of tall children
204	set of tall children / children
205	set of short children
206	set of short children / children
207	set of three black cats and one white cat
208	three black cats
209	three black cats / three black and one white cat
210	one white cat / three black and one white cat
211	two yellow cats

(cont.)

Slide Number	Description
212	two yellow cats / three black and one white cat
213	sheet of white paper with SUBSETS printed at bottom. Above are six squares: one containing 1 red block, 1 with one yellow block, 1 with one green block, 1 with a red and a green block, another with a green and a yellow block, and the last with a yellow and a red block
214	white paper with SUBSETS at top. Three squares one containing a blip, one a blop, and one a bleep. 3 rectangles: one with a blip and a blop, one with a blop and a bleep, and one a bleep and a blip
215	ditto 214, cow with circle around it, pig with a circle around it
216	sheet of white paper, a pig on one half, a cow on the other half
217	sheet of white paper divided into 3 squares and 3 rectangles: one square contains a pig, one a cow, one a horse. One rectangle has a pig and a cow, another a cow and a horse, and the last a horse and pig
218	ditto 215, with green circle around the cow and the horse, blue circle around the pig and the horse, red circle around the pig and the cow, a black circle around the pig, a yellow circle around the horse, an orange circle around the cow.
219	4 green blocks matched with 4 blue blocks plus one extra green block
220	ditto 216, red lines drawn from 4 children to 4 chairs, 1 extra child
221	pegboard with red pegs down far right and five green peg down far left, 5 rubberbands, each stretched between a green and a red peg
222	ditto 217, each vase with a flower drawn in it
223	magnetic mat with 4 magnetic shapes matched to 4 magnetic fruits, 1 extra fruit
224	ditto 18, 4 footballs drawn in space C and a line drawn from each boy to each football. Either 3 or 4 dolls drawn in space B with lines joining girls and dolls so there is 1 extra girl or doll.
225	5 large yellow plastic beads and 5 large blue plastic beads joined in pairs of 1 blue and 1 yellow
226	ditto 219 with an apple drawn on each plate
227	piece of blue paper with 3 soap animals / 6 paper cups white card which says $3 \ll 6$
228	ditto 221, cups green, dog brown, note card which says $3 \ll 6$
229	board with 4 padlocks with keys hanging. There is an extra key. Card which says $4 \ll 5$
230	ditto 222, lines drawn between 4 padlocks and 4 keys, 1 extra key at bottom of page: $4 \ll 5$

(cont.)

Slide Number	Description
231	blue board with two wooden pegs, 4 green squares on left peg, 3 yellow squares on right peg, card which says $4 < 3$
232	slide 231, 4 green squares on left peg, 3 yellow squares on right peg at bottom of page $4 < 3$
233	3 nuts with 3 bolts fastened to them, 1 extra bolt, card which says $3 < 8$
234	slide 233, lines drawn between 3 nuts and 3 bolts. There is 1 extra bolt. Underneath bolts: There are 8 bolts. Underneath nuts: There are 3 nuts. At bottom of page $3 < 8$
235	not assigned
236	not assigned
237	not assigned
238	not assigned
239	4 baking cups and 2 spoons of thread on a blue paper
240	2 chairs and 2 children
241	set of two children
242	set of two children on the set of swings
243	two swings and two children
244	set of seven pegboard-colored pegs on pegboard
245	set of seven rubber bands
246	set of rubber bands on the pegs // one to one
247	set of seven rubber bands // beghoard with seven colored pegs
248	set of five hands
249	set of five watches on five hands
250	set of five hands // set of five watches
251	set of four cookies
252	set of four glasses of milk
253	set of four glasses of milk // set of four cookies
254	set of cookies and milk with arrows
255	set of three birthday cards
256	set of three envelopes
257	set of three envelopes // set of three birthday cards
258	set of three birthday cards partly in the envelopes
259	set of eight football helmets
260	set of eight football player's heads
261	set of eight football helmets // eight football player's heads
262	set of eight football helmets on player's heads
263	eight football helmets // nine football helmets
264	nine football helmets
265	eight football player's heads // nine football helmets
266	eight football helmets on player's heads plus one extra helmet
267	board with ten holes
268	board with ten holes // ten colored dowels

(cont.)

Slide Number	Description
269	ten dowels in the holes
270	six dowels
271	board with ten holes / six dowels
272	six dowels in holes in ten-hole board
274	ten colored dowels
275	dittos 830, 3 spoons and 4 cupcakes drawn on bottom
276	oatmeal / 3
277	children / 3
278	4 cookies / 4
279	not assigned
280	6 balloons / 3 3 3
281	2 pear / 3 3 3
282	8 [illegible] / 3 3 3
283	6 spoons / 4 pots
284	5 > 2
285	pen[illegible] / 1
286	not assigned
287	not assigned
288	not assigned
289	not assigned
290	not assigned
291	not assigned
292	not assigned
293	not assigned
294	not assigned
295	not assigned
296	not assigned
297	not assigned
298	not assigned
299	not assigned
300	not assigned
301	white union sign
301a	black union sign
302	white union sign / "together with"
302a	black union sign / "together with"
303	brackets, union sign, brackets
304	fish
305	fish / three animals
306	bird, cat, dog, and fish
307	3 girls / 5 boys
308	four pieces of fruit / two pieces of pie
309	the new set of fruit and pie
310	firetruck and police car
311	fireman and policeman
312	firet[illegible] and police car / fireman and policeman
313	new set of fireman, policeman, firetruck, and police car
314	set of five sailboats
315	set of five lifejackets

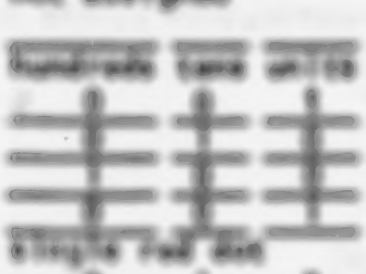
(cont.)

Slide Number	Description
316	set of five sailboats / set of five lifejackets
317	new set of sailboats and lifejackets
318	set of six toothbrushes
319	tube of toothpaste
320	set of six toothbrushes / tube of toothpaste
321	new set of toothbrushes and toothpaste
322	tennis racket
323	golf clubs / tennis racket
324	new set of golf clubs and tennis racket
325	not assigned
326	baby and two booties
327-360	not assigned
361	fish, bird, dog, cat
362	not assigned
363	four animals in one order / animals in different order
364	doll, truck, ball
365	boy, girl
366	boy, girl / doll, truck, ball
367	doll, truck, ball / boy, girl
368	doll, ball, truck, boy, girl
368a	ball, boy, truck, doll, girl
369	truck, ball, doll, girl, boy
370	firetruck, policecar / brackets
371	four funny faces
372	six funny hats
373	four funny faces / six funny hats
374	unlimed set: two faces, six hats, two faces
375	unlimed set: four faces, six hats
376	two football helmets
377	footballs / helmets
378	footballs and helmets
379	helmets and footballs
380	green triangle, yellow circle
381	red rectangle
382	yellow circle, green triangle / red rectangle
383	red rectangle, green triangle, yellow circle
384	not assigned
385	green triangle, yellow circle, red rectangle
386	five boys / brackets
387	boys / brackets
388	doll / truck, ball
389	doll, truck/ball
390	one baseball bat
391	five baseballs
392	three baseball gloves
393	(five baseballs) (one bat) (three baseball gloves)
394	same as #393 with numerals 5, 1, 3, above
395	counting board with 10 white rings on it

(cont.)

Slide Number	Description
206	regrouping 10 units
207	counting board with one base ring
208	2 counting boards, one with one ten, the other with 10 units 10=10
209	counting board with 10 units rings
600	regrouping 10 units
601	counting board with 1 ten and 2 units, numeral
602	two counting boards, one with 1 ten and 2 units, the other with 10 units 12=12
603	counting board with 14 units
604	regrouping 14 units
605	counting board with 1 ten and 4 units, numeral
606	2 counting boards, one with 1 ten and 4 units, the other with 14 units 14=14
607	counting board with 10 tens, numeral 100 below picture
608	regrouping 10 tens
609	counting board with one hundreds ring
610	2 counting boards, one containing 10 tens, the other 1 hundred 100=100
611	counting board with 12 tens, numeral
612	regrouping 12 tens
613	counting board with 1 hundred and 2 tens, numeral
614	2 counting blocks, one with 1 hundred and 2 tens, the other with 12 tens 120=120
615	counting board with 18 tens and numeral
616	regrouping 18 tens
617	counting board with 6 tens and 1 hundred
618	2 counting boards, one with 1 hundred and 6 tens, the other with 16 tens 160=160
619	place value chart with 10 ones, numeral
620	regrouping 10 ones
621	place value chart with one x in ten's place
622	1 ten = 10 units 10=10
623	12 units on place value chart
624	regrouping 12 units
625	1 ten, 2 units with numeral 12
626	2 place value charts, one containing 1 ten and 2 units, the other 12 units 12=12
627	14 units with numeral
628	regrouping 14 units
629	1 ten, 4 units with numeral
630	2 place value charts, one containing 1 ten and 4 units, the other 14 units 14=14
631	10 tens with numeral 100
632	regrouping 10 tens
633	place value chart with one hundred
634	2 place value charts, one with 1 hundred and 1 with 10 tens 100=100
635	12 tens with numeral

(cont.)

Title Number	Description
636	regrouping 13 tens
637	1 hundred and 3 tens with numeral
638	8 place value charts, one with 1 hundred and 3 tens, the other with 13 tens 130=130
639	16 tens and 4 units with numeral 164
640	regrouping 164
641	1 hundred, 6 tens, 4 units
642	1 hundred, six tens, 4 units = 16 tens and 4 units 164=164
643-679	not assigned
680	
681	
682	
683	
684	
685	
686	
687	out of sets 7
688	out of horses 7
689	out of golf clubs 7
690	out of fountains /
691	out of books /
692	out of dishes /
693	single dot
694	ten dots
695	one hundred dots
696	one unit
697	six units
698	ten units
699	/ 1 unit
700	/ ten units
701	/ one hundred units
702	one hundred units
703	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
704	one ten and one unit = eleven units (illegrammatic) no words
705	one ten and two units = twelve units (illegrammatic)
706	one ten and three units = thirteen units (illegrammatic)
707	one ten and four units = fourteen units (illegrammatic)
708	one ten and five units = fifteen units (illegrammatic)
709	one ten and six units = sixteen units (illegrammatic)
710	one ten and seven units = seventeen units (illegrammatic)
711	one ten and eight units = eighteen units (illegrammatic)
712	one ten and nine units = nineteen units (illegrammatic)
713	one ten = ten units (illegrammatic)
714	one ten and two units = twelve units (with word explanation underneath)

*Notes: the words "hundreds", "tens", and "units" appear under all underlined numbers in slides

(cont.)

Slide Number	Description
935	one ten and ten units = eleven units (diagrammatic)
936	one unit, one ten, and six units
937-939	not assigned
940	one hundred = ten tens with poles
941	one ten = ten units with poles
942	[illegible] with diagram
943	[illegible] with diagram
944	ten units = one ten with sticks and words
945	ten units = one hundred with sticks and words
946	Hundreds Tens Units xxx xx xxx xxx xxx xxx
947	Hundreds Tens Units xxx xxx xxx x xxx x xxx x
948	Hundreds Tens Units xxx xxx xx
949	Tens Units x xxx xxx xxx xxx xxx 1 ten = 10 units
950	Hundreds Tens Units xxx xxx xxx xx xxx xx xxx xxx
951	Hundreds Tens Units xxx xxx xxx xxx xxxx xx xxxx x
952	Hundreds Tens Units xxx xx xxx xxx xx
953	Hundreds Tens Units x xxx xxx xxx xxx x 1 hundred = 10 tens
954	ten ten = ten units (with diagram)
955	one hundred = ten tens (with diagram)
956	Hundreds Tens Units (background)

(cont.)

Slide Number	Description
557	xx
558	xxx xxx xxx xxx
559	xx xx x
560	12 - green light, 13 - yellow light, 11 - red light
561	15 - green light, 16 - yellow light, 14 - red light
562	tens - green light, units - yellow light, hundreds - red light
563	3 tens - green light, 4 tens - yellow light, 8 tens - red light
564	2 tens - green light, 1 ten - yellow light, 6 tens - red light
565	tens - green light, tens - yellow light, tens - red light
566	5 - green light, 2 - yellow light, 3 - red light
567-599	not assigned
600	one unit block / ▯
601	one ten block / ▮
602	one hundred block / ▮▮
603	2 ten blocks / ▮▮
604	3 ten blocks / ▮▮▮
605	4 ten blocks / ▮▮▮▮
606	5 ten blocks / ▮▮▮▮▮
607	6 ten blocks / ▮▮▮▮▮▮
608	7 ten blocks / ▮▮▮▮▮▮▮
609	8 ten blocks / ▮▮▮▮▮▮▮▮
610	9 ten blocks / ▮▮▮▮▮▮▮▮▮
611	1 ten block and 6 unit blocks / ▮ ▯▯▯
612	1 ten block and 5 unit blocks / ▮ ▯▯▯
613	2 ten blocks and 7 unit blocks / ▮▮ ▯▯▯
614	2 ten blocks and 3 unit blocks / ▮▮ ▯▯▯
615	1 | 1 | 0
616	1 hundred block and 1 ten blocks
617	1 | 2 | 0
618	1 hundred block and 2 ten blocks
619	1 | 1 | 4
620	1 hundred block, 1 ten blocks, and 4 unit blocks
621	1 | 6 | 3
622	1 hundred block, 6 ten blocks, and 3 unit blocks
623	1 | 0 | 0
624	1 hundred blocks
625	3 | 0 | 0
626	3 hundred blocks
627	4 | 0 | 0

(cont.)

Slide Number	Description
628	4 hundred blocks
629	1 0 0
630	5 hundred blocks
631	6 0 0
632	6 hundred blocks
633	7 0 0
634	7 hundred blocks
635	8 0 0
636	8 hundred blocks
637	9 0 0
638	9 ten blocks
639	0 1 5
640	
641	
642	
643	
644	
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660	
661	
662	
663	
664	5 gold stars and 6 blue stars
665	ditto 033, 5 large stars colored and 5 small stars colored
666	3 yellow counters and 2 blue counters
667	ditto 034, radios and television sets colored brown
668	5 party hats and 2 horns
669	party hats and horns colored red
670	18 unit blocks and 5 ten blocks
671	ditto 037, 5 orange ten blocks and 9 beige unit blocks
672	3 ten blocks, 6 unit blocks 2 3 6
673	ditto 038 2 3 6
674	7 ten blocks 0 7 2
675	ditto 039, 2 7 3
676	3 blocks of 100, 3 2 2

(cont.)

Slide Number	Description
677	ditto 040, 3 0 0
678	2 ten blocks, 4 unit blocks 0 2 4
679	ditto 041, 0 2 4
680	5 ten blocks, 0 5 0
681	ditto 042, 0 5 0
682	1 hundred block, 4 ten blocks, and 2 unit blocks 1 4 2
683	ditto 043, 1 4 2
684-699	not assigned
700	chairs / cars
701	pots / 4
702	spoons / 6
703	train / pots
704	0 not greater than 3
705	8 not greater than 8
706	5 greater than 1
707	3 greater than 0
708	1 greater than 3
709	1 less than 3
710-720	not assigned
721	greater than sign
722	9 greater than 1
723	2 children / 4 flowers
724	flowers / children
725	4 greater than 2
726	2 not greater than 4
727	2 children holding 4 flowers with two extra
728	combs / toothbrushes
729	7 greater than 6
730	seven combs and six toothbrushes with arrows
731	fireman, policeman, firetruck, policecar / brackets
732	4 greater than 0
733-736	not assigned
737	four horses
738	three chickens
739	horses / chickens
740	4 greater than 3
741	one piece of candy
742	ten pieces of candy / one piece of candy
743	10 greater than 1
744	ten candles / two candles
745	two candles
746	10 greater than 2
747	one fish
748	nine fish / one fish
749	fish / 1
750	horses / 4
751	chickens / 3
752	cards / envelopes
753	cards in envelopes with two extra

(cont.)

Slide Number	Description
754	not assigned
755	toothbrushes / 6
756	hands / glasses of milk
757	hot dogs / 8
758	hot dogs / boys
759	8 greater than 5
760	children / 8
761	children / watches
762	balloons / 6
763	balloons / girls
764	girls / 3
765	6 greater than 3
766	dowels / 6
767	birds / dowels
768-779	not assigned
780	ten block with numeral 10 on top
781	one block with numeral 1 on top
782	two block with numeral 2 on top
783	three block with numeral 3 on top
784	four block with numeral 4 on top
785	five block with numeral 5 on top
786	six block with numeral 6 on top
787	seven block with numeral 7 on top
788	eight block with numeral 8 on top
789	nine block with numeral 9 on top
790	the three blocks matched
791	5 = 5
792	3 = 3
793	the five blocks matched
794	9 = 9
795	the nine blocks matched
796	7 greater than 3
797	the seven block and the three block
798	7 not equal to 3
799	3 less than 7
800	the five block and the nine block
801	5 less than 9
802	9 greater than 5
803	5 not equal to 9
804	the four block and the five block
805	4 not equal to 5
806	4 less than 5
807	5 greater than 4
808	the seven block and the eight block
809	7 not equal to 8
810	7 less than 8
811	8 greater than 7
812	the six block and the one block
813	6 not equal to 1

(cont.)

Slide Number	Description
014	6 greater than 1
015	1 less than 6
016	one (or unit) block
017	two block
018	not assigned
019	three block
020	four block
021	five block
022	six block
023	seven block
024	eight block
025	nine block
026	ten block
027	the five block and the nine block with numerals
028	the five blocks matched with numerals
029	the nine blocks matched with numerals
030	the four block and the five block with numerals
031	the seven block and the three block with numerals
032	the three blocks matched with numerals
033	the seven block and the eight block with numerals
034	the six block and the one block with numerals
035	the set of one - ten blocks with numerals
036	the set of one - ten blocks without numerals
037	ditto 200, 3 yellow beads, 2 green cars, 1 blue cat 2 3 1
038	1 soap animal on blue paper with numeral, 2 cars on green paper with numeral, 3 beads on yellow paper with numeral
039	ditto 201, 5 red circles, 2 blue erasers, 4 green clothespins 5 2 4 (each circled)
040	2 erasers on a blue paper with numeral, 4 clothespins on green paper with numeral, 5 counters on red paper with numeral
041	ditto 202, 7 orange rubber bands, 8 purple paper clips, 6 yellow cotton balls
042	8 paper clips on purple paper, 6 cotton balls on yellow paper, 7 rubber bands on orange paper
043	ditto 203, matching numerals with correct number of objects
044	4 sheets of paper, one with 0 on it, one with 3 straws and a numeral, another with 4 green squares and a numeral, and one with 9 blocks and a numeral
045	ditto 204, red plates, green candles, purple eraser 3 2 1
046	2 circles on green paper with numeral, 3 dishes on red paper with numeral, and 1 eraser on blue paper with numeral
047	ditto 205, 5 straws 5, 4 sticks 4, 2 beads 2
048	4 sticks on brown paper with numeral, 2 beads on orange paper with numeral, 5 straws on red paper with numeral
049	ditto 206, 8 yellow buttons, 7 blue clothespins, 6 black dollar bills

(cont.)

Slide Number	Description
050	6 bills on black paper, 8 buttons on yellow paper, 7 clothespins on blue paper
051	ditto 207, lines connecting 1st 4 boxes to first 4 numerals
052	blank sheet of paper with 0 on it, paper with 9 disks and numeral, paper with 2 pieces of fruit and numeral, paper with 6 candles and numeral
053	ditto 208, 2 large buttons in one square, 5 small buttons in other square
054	2 sheets of paper, one with 2 large buttons, the other with 2 small buttons
055	ditto 209, following sets of dominoes circled: (1) 1/3,2,2 (3) 1/4, 4/3 (3) 1/1, 2,0
056	3 sheets white paper, one with dominoes 3/1 and 2/2, another with 2/0 and 1/1, and a third with 4/1, 4/3
057	ditto 210, 2 $10 bills in one square, 5 coins in the other
058	2 pieces of paper money, 5 coins
059	ditto 211, following sets circled: (1) 1 circle, 3 circles (2) 2 triangles, 2 squares (3) 4 squares, 4 triangles
060	3 sheets paper, one with 2 triangles and 2 squares, another with 4 squares and 4 triangles, a third with 1 circle and 4 circles
061	ditto 212, equals sign = between the top two boxes
062	5 straws and 5 clothespin on red paper = sign. 6 buttons and 3 candles on yellow paper ≠ sign
063	ditto 213, 3 = 3 3 ≠ 4 both circled
064	3 blocks and 3 coins on green paper 3 = 3 4 beads and 3 paper clips on yellow paper 3 ≠ 4
065	ditto 214 = sign between top two boxes
066	on yellow paper: 5 straws, 5 dishes, = sign. On green paper: 3 pieces of fruit, 6 counters, ≠ sign
067	ditto 215 3 = 3 circled 3 ≠ 4 circled
068	On green paper: 3 cars, 4 rubberbands, ≠ On yellow paper: 3 green squares, 3 sticks, 3 = 3
069	ditto 216, 5 red cotton balls, 6 green straws
070	5 cotton balls on a red paper, 6 straws on a green paper
071	ditto 217, 4 > 1 (circled) and 3 > 2 (circled)
072	3 buttons and 2 clothespins on a green paper, card which says 3 1 4 blocks and a car on the red paper, 4≱1
073	ditto 218, 5 blue straws, 6 orange beads
074	5 straws on a blue paper, 6 beads on a green paper
075	ditto 219, 4 > 1 (circled) 3 > 2 (circled)
076	3 diamond shapes and 2 sticks on pink paper, 3 > 2. 4 counters and a rubberband on a green paper, 4 > 1
077	ditto 220, 4 balloons and 3 blocks colored purple
078	4 balloons and 3 blocks on a purple sheet of paper
079	ditto 221, items in top half circled in yellow, on bottom circled in blue
080	4 cotton balls and 1 playing card on blue paper, 2 paper cups and 3 band-aids on orange paper

(cont.)

Slide Number	Description
001	disco 222, 4 pieces of money and 3 dolls colored red
002	3 dolls and 4 pieces of money
003	disco 223, items on top half of paper circled in green, bottom in yellow
004	3 straws and 2 erasers on green paper/ 3 candles and 1 block on yellow paper
005	disco 224, 10 green balloons on top half 1 0, 3 yellow balloons on bottom 3
006	10 balloons on green paper with numeral, 3 balloons on yellow paper with numeral
007	disco 225, numeral 4 circled on left half of paper, 9 circled on right half
008	9 straws, numeral 5/4 cups, numeral 4
009	disco 226, 10 bandaids colored orange, numeral / 3 purple bandaids, numeral
010	3 bandaids, numeral on purple paper, 10 bandaids, numeral on orange paper
011	disco 227, numeral 4 circled/ numeral 9 circled
012	9 spoons, numeral, 4 spoons, numeral
013	disco: 228, 11 units on top counting block, 1 ten and 1 unit on bottom
014	counting blocks representing 11 as 11 units or 1 ten and 1 unit
015	disco 229, counting board in lower left circled (represents 16)
016	counting board with 1 ten and 6 units
017	disco 230, 14 tens on top counting block, 1 hundred and 4 tens below
018	regrouping 14 tens
019	disco 230, regrouping 11 units
020	hundreds tens units background
021	325 +413 738
022	695 +261 956
023	231 +116 347
024	325 +163 488
025	612 +329 941
026	325 +538 863

(cont.)

Slide Number	Description
907	321 ×438 3
908	321 ×438 963
909	730 ×145 0
910	730 ×145
911	730 ×145 880
912	960 ×365
913	960 ×365 4
914	960 ×365 950
915	536 ×215
916	536 ×215 7
917	536 ×215 1502
918	243 - green light, 326 - yellow light, 213 - red light
919	111 - green light, 121 - yellow light, 101 - red light
920	green light, yellow light, red light
921	15 - green light, 16 - yellow light, 14 - red light
922	12 - green light, 13 - yellow light, 11 - red light
923	top half - 1 ten and 1 unit, bottom half - 11 units
924	dittо 231, answer in lower left corner circled
925	5 yellow ten disk and 6 red unit disks
926	ditto 230, regrouping 140
927	top half - 14 tens, bottom - 1 hundred, 4 tens
928-939	not assigned
940	1 bundle of ten straws, 5 single straws 1 5. 1 bundle of 10 sticks 3 single sticks, 1 3
941	ten sticks circled in top half 1 3, ten straws circled in bottom 1 3
942	counting board with 2 hundreds, 2 tens, 4 ones, card which says 224

(cont.)

Slide Number	Description
943	ditto 234, counting block with 2 hundreds, 3 tens, 4 ones card saying 213 234
944	1 ten and 3 single pipe cleaners on green paper, 1 ten and 5 single balloons on orange paper
945	ten pipe cleaners circled in top half 1 3, 10 balloons circled in bottom 1 5
946	2 hundreds, 2 tens, 4 units 1) 213 2) 234
947	ditto 236, 2 hundreds, 2 tens, 4 units 1) 213 2) 234
948	group of 10 pennies and 6 pennies on a yellow paper, 1 dime and 6 pennies on green paper
949	ditto 237, top half-sixteen pennies 16¢, bottom half - 1 dime and 6 pennies colored green 16¢
950	238 +115
951	238 +115 4
952	238 +116 354
953	116 +238
954	116 +238 4
955	116 +238 354
956	019 +253
957	019 +253 7
958	019 +253 77
959	019 +253 777
960	146 +231
961	146 +231 77
962	146 +231 377

(Cont.)

Title Number	Description
963	[illegible]
964	[illegible]
965	[illegible]
966	[illegible]
967	[illegible]
968	[illegible]
969	[illegible]
970	[illegible]
971	[illegible]
972	place value chart with 8 tens and 1 unit
973	dimes 238, regrouping
974	1 group of 11 bills and 6 cents on red paper, 1 ten and 6 ones on blue paper
975	dimes 235- top half- $15 15 cents, bottom half-1 ten and 6 cents colored blue $15
976	counting board representing 81
977	dimes 240, regrouping
978	paper ten representing 142
979	dimes 241, stick ten representing 136 and 142
980	bundels grouped to show 23
981	dimes 242, 2 groups of 10 bundels circled, 3 left, numeral
982	142 represented with sticks
983	dimes 243, regrouping
984	muffin cups grouped to represent 23 (words and numbers at bottom)
985	dimes 244, grouping muffin cups to form 23
986	car inside square, balloon inside triangle, animal inside rectangle, and dish inside circle
987	dimes 245, car drawn in square, balloon in triangle, dish in circle, and animal in rectangle
988	plastic magnetic shapes attached to metal mat to fit their outlines

(cont.)

Slide Number	Description
929	Circle 2nd, black square, red triangle, orange circle, blue rectangle
930	4 shapes matched to their corresponding outlines
931	Circle 2nd, 3 purple triangles, 2 brown squares, 2 yellow circles, 1 green rectangle.
932	2 small blue triangles
933	2 small yellow squares
934	2 small blue rectangles
935	2 small yellow circles
936	2 small green rectangles
937	2 small red squares
938	2 yellow squares
939	Eight blue rectangles
0800	[illegible]
0801	[illegible]
0802	[illegible]
0803	[illegible]
0804	[illegible]
0805	[illegible]
0806	[illegible]
0807	[illegible]
0808	[illegible]
0809	[illegible]
0810	[illegible]
0811	[illegible]

(cont.)

Slide Number	Description
0010	[illegible]
0011	[illegible]
0012	[illegible]
0013	[illegible]
0014	[illegible]
0015	[illegible]
0016	[illegible]
0017	[illegible]
0018	[illegible]
0019	[illegible]
0020	[illegible]
0021	puppet
0022	circle (puppet head) accented
0023	circular region (puppet head) accented
0024	square (puppet body) accented
0025	square region (puppet body) accented
0026	rectangle (puppet legs and arms) accented
0027	rectangular region (puppet legs and arms accented
0028	not assigned
0029	triangle (puppet hat) accented
0030	triangular region (puppet hat)accented
0031	triangle - green light, square - yellow light, circle - red light
0032	calve
0033	[illegible]
0034	[illegible]
0035	book
0036	[illegible]
0037	picture
0038	ice cream cone

(cont.)

Slide Number	Description
1039	ice cream cone with circular region accented
1040	cone with triangular region accented
1041	wedge of pie
1042	checkerboard with checkers
1043	checkerboard
1044	checkers
1045	blue triangle, yellow circle, green rectangle, red square
1046	yellow circle, green rectangle, red square
1047	blue triangle, green rectangle, red square
1048	blue triangle, yellow circle, red square
1049	blue triangle, yellow circle, green rectangle
1050	red square, green rectangle, blue triangle
1051	yellow circle, blue triangle, green rectangle, red square
1052	ice cream cone / wedge of pie
1053	book / picture
1054	house of shapes
1055	house: triangular region accented
1056	house: triangle accented
1057	house: rectangular region accented
1058	house: rectangle accented
1059	house: square region accented
1060	house: square accented
1061	house: circular region accented
1062	house: circle accented
1063	basketball, nickel, dime
1064	penny, clock face, circle
1065	ruler, flag
1066	piece of paper, rectangle
1067	block, book, jack-in-the-box
1068	checkerboard and rectangle
1069	piece of pie and witch hat
1070	piece of cake and triangle
1071	blue triangle
1072	238 +516 754
1073	green rectangle
1074	yellow circle
1075	witch hat, piece of pie / piece of cake, triangle
1076	jack-in-the-box, block, book / checkerboard, rectangle
1077	basketball, nickel, dime / penny, clock face, circle
1078	ruler, flag / piece of paper, rectangle
1079	small red circle / small clear circle
1080	small green triangle / small clear triangle
1081	large blue triangle / large clear triangle
1082	small yellow square / small clear square
1083	large red square / large clear square
1084	small blue rectangle / small clear rectangle
1085	blue rectangle

(cont.)

Slide Number	Description
1086	green triangle
1087	red square
1088	red circle
1089	365 +251 6
1090	yellow square
1091	562 +363 5
1092	439 +326 5
1093	small yellow circle on large blue triangle
1094	small green rectangle on large yellow square
1095	blue triangle within yellow circle
1096	small red square on large blue triangle
1097	blue triangle within tiny yellow circle
1098	blue triangle within green rectangle
1099	blue triangle within red square
1100	yellow square within blue triangle
1101	yellow square within green rectangle
1102	yellow square within yellow circle
1103	yellow square within red square
1104	light blue rectangle within dark blue triangle
1105	yellow circle superimposed upon green rectangle
1106	large green rectangle / large clear rectangle
1107	large yellow circle / large clear circle
1108	small blue triangle on large light blue rectangle
1109	small green rectangle on large blue triangle
1110	small blue triangle on large yellow square
1111	clear small triangle
1112	clear small circle
1113	clear small rectangle
1114	clear small square
1115	clear big triangle
1116	clear big circle
1117	clear big rectangle
1118	clear big square
1119	six circles, various sizes and colors
1120	six circles, various sizes - all clear
1121	six triangles, various sizes and colors
1122	six triangles, various sizes - all clear
1123	six squares, various sizes and colors
1124	six squares, various sizes - all clear
1125	six rectangles, various sizes and colors
1126	six rectangles, various sizes - all clear
1127-1131	not assigned
1132	small yellow circle on large yellow square

(cont.)

Slide Number	Description
1133	small green rectangle on large yellow circle
1134	2 right triangles, purple and red
1135	ditto 247, 2 right triangles colored yellow
1136	2 orange circles and 2 purple triangles
1137	ditto 248, 2 circles and 2 triangles colored purple
1138	orange squashed triangle at top; on blue paper - a red square, a green rectangle, and a black rectangle, on red paper - yellow and purple squashed triangles.
1139	ditto 249, orange squashed triangle on top, 2 squashed triangles colored red; circle, square, and 2 rectangles colored blue
1140	2 yellow rectangles
1141	two large red congruent squares (regions)
1142	two large blue congruent triangles (regions)
1143	two large green congruent rectangles (regions)
1144	two large yellow congruent circles (regions)
1145	ditto 250, 2 rectangles colored green
1146	2 blue squares, 2 yellow rectangles
1147	ditto 251, 2 squares and 2 rectangles colored red
1148	red square at top; on orange paper-brown and green squares on purple paper-blue rectangle, yellow rectangle, red circle, orange triangle
1149	two large blue triangles in one position
1150	two large blue triangles in another position
1151	not assigned
1152	two large green rectangles in different positions
1153	triangle, square, rectangle, circle, triangle - same color
1154	dark blue triangle, clear square, clear rectangle, clear circle, dark blue triangle
1155	circle, triangle, square, circle, rectangle - same color
1156	yellow circle, clear triangle, clear square, yellow circle, clear rectangle
1156a	rectangle, triangle, square, circle, rectangle - same color
1157	green rectangle, clear triangle, clear square, clear circle, green rectangle
1158	square, triangle, rectangle, square, circle - same color
1159	red square, clear triangle, clear rectangle, red square, clear circle
1160	large circle, small circle, large circle, large circle - all yellow
1161	three large green rectangles, one small green rectangle, one large green rectangle
1162	three large squares, one small square - all red
1163	one large triangle, one small triangle, three large triangles - all blue
1164	ditto 252, red square at top, 2 squares colored orange, 2 rectangles, circle and triangle are purple
1165	2 large purple congruent circles
1166	2 small purple congruent circles

(cont.)

Slide Number	Description
1167	1 large and 1 small purple circle
1168	1 large and 1 small light blue rectangle
1169	1 large and 1 small yellow square
1170	2 small orange congruent triangles
1171	2 large orange congruent triangles
1172	1 large and 1 small orange triangle
1173	325 ÷ 13 = 25
1174	325 ÷ 13 = 25 r 0
1175	325 ÷ 13 = 25
1176	851 ÷ 116 = 7
1177	851 ÷ 116 = 7 r 39
1178	851 ÷ 116 = 7 r 39
1179	652 ÷ 124 = 5
1180	652 ÷ 124 = 5 r 32
1181	652 ÷ 124 = 5 r 32
1182	325 ÷ 130 = 2 r 65
1183	868 ÷ 215 = 4 r 28
1184	325 ÷ 151 = 2
1185	325 ÷ 151 = 2 r 23
1186	325 ÷ 151 = 2 r 23
1187	905 ÷ 301 = 3
1188	905 ÷ 301 = 3 r 2

(cont.)

Title Number	Description		
1189	005 •001 05		
1190		231 •016	
1191	231 •016 3		
1192		231 •016 43	
1193	732 •168 88		
1194		536 •226 82	
1195	132 •126		
1196		132 •126 8	
1197	672 •072		
1198		672 •072 57	
1199	289 •189		
1200		690 •246	
1201	690 •246 6		
1202		510 •229	
1203	510 •229 3		
1204		598 •156	
1205	598 •156 65		
1206		625 •288	
1207	772 •143		

(cont.)

Slide Number	Description
1208	$\frac{7+2}{3+6}$
1209	red square at top of paper, blue and yellow squares below
1210	ditto 253, 3 squares same size colored red
1211	3 orange rectangles
1212	ditto 254, 3 rectangles colored orange
1213	2 yellow triangles and 2 yellow circles
1214	ditto 255, 2 blue circles and 2 brown triangles
1215	black circle at top of paper - red and blue circles below it
1216	ditto 256, 3 congruent circles colored black
1217	3 green triangles
1218	ditto 257, 3 triangles colored green
1219	2 yellow squares and 2 yellow rectangles
1220	ditto 258, 2 yellow rectangles and 2 orange squares
1221-2600	not assigned
2601	equal sign
2602	not assigned
2603	children in chairs
2604	$2 = 2$
2605	set of four flowers
2606	flowers / trees
2607	flowers under trees
2608	$4 = 4$
2609	watches / hands
2610	$5 = 5$
2611	four envelopes
2612	cards / envelopes
2613	cards in envelopes with extra envelope
2614	$4 \neq 3$
2615	$\emptyset$
2616	one bottle
2617	baby / bottle
2618	baby drinking from bottle
2619	$1 = 1$
2620	two bottles
2621	baby drinking from bottle and one extra
2622	baby / two bottles
2623	$1 \neq 2$
2624	one bottle / two bottles
2625	$8 = 8$
2626	$8 \neq 9$
2627	empty set / empty set
2628	$0 = 0$
2629	empty set = empty set
2630	six fish
2631	six fishing poles
2632	fish / fishing poles
2633	fish nibbling at lines

xxx

(cont.)

Slide Number	Description
D634	6 = 6
D635	seven combs
D636	combs / rubberbands
D637	combs in one-to-one correspondence with rubberbands
D638	7 = 7
D639	chairs
D640	not assigned
D641	boy and girl / 2
D642	flowers / 4
D643	birthday cards / 3
D644	envelopes / 4
D645	umbrellas / birds
D646	3 # 9
D647	bottles / 2
D648	helmets / 8
D649	hands / 8
D650	helmets / 9
D651	seven rubberbands / 7
D652	combs / 7
D653	6/ six fish
D654	6/ six fishing poles
D655-D659	not assigned
D660	baby and bottle
D661	milk / pie
D662	milk with pie underneath
D663	2 less than 4
D664	less than sign
D665	five envelopes
D666	three cards / five envelopes
D667	cards in envelopes with two extra envelopes
D668	3 less than 5
D669	four faces / six hats
D670	4 less than 6
D671	train cars / fish
D672	8 less than 9
D673	swings / boy and girl
D674	2 not less than 2
D675	two animals / three animals
D676	2 less than 3
D677	watches / dishes
D678	5 less than 8
D679	four spoons
D680	pots / spoons
D681	4 not less than 4
D682	six spoons
D683	four spoons / six spoons
D684	4 less than 6
D685	eight hot dogs
D686	milk / hot dogs

(cont.)

Slide Number	Description
2687	7 less than 8
2688	cells / 4
2689	not assigned
2690	6 hats / 6
2691	4 faces / 4
2692	2 wolves / 9 umbrellas
2693	8 < 9
2694	pencils / children
2695	9 pencils / 9
2696	3 < 8
2697	ball / 1
2698	1 < 10
2699	piece of candy / 1
2800	Mr. Question
2801	University of Wisconsin answer sheet
2802	answer sheet with practice questions outlined in red

APPENDIX II.

LESSON ONE: ILLUSTRATIVE
SCRIPTS SHOWING EIGHT
CURRICULAR, INSTRUCTIONAL, MEDIA
OPTIONS

LESSON ONE:
CONNECTING-ANGLES ASSEMBLAGE
INTRODUCTION TO SETS

1 Hello! I want you to meet Mr. Mathematics. He's going to help me show you some things about mathematics which you may not have learned before. As you can see, he has three baskets of mathematics: numbers, shapes, and sets. In Mr. Mathematics' first basket are numbers. You probably know about this kind of mathematics. Sometimes we call this kind arithmetic. There are two other kinds of mathematics you may not know about. In Mr. Mathematics' second basket are shapes. In Mr. Mathematics' third basket are sets. We'll be exploring the mathematics in each of Mr. Mathematics' baskets. We'll be studying numbers, shapes, and sets. Today we are going to talk about things you often see grouped together. Let's find out why we group some things together.

2 We often see dishes on a breakfast table. Are these dishes alike in any way? We can see that all the dishes are the same color, but is color the best reason for putting them together in a group? Are the bowls, dishes? Are the cups, dishes? Are the plates, dishes? What is the best reason for putting the plates, the cups and the bowls together in a group?

3 You may have seen these before on the playground. What are they? Why do we place the two swings together? Do we use the two swings for the same purpose?

4 Here is one of the swings. How do we use this swing? Do we swing in the swing?

5 Here is the group of swings. Do we use both swings for the same purpose?

6 Inside your desk is a large envelope with the number one on it. Open the envelope. Put the three sheets of paper on your desk. There is one green sheet, one red sheet and one yellow sheet. Place the set of blocks on the green sheet. Place the set of dishes on the red sheet. Place the set of money on the yellow sheet.

7 Check your work. Do the three sets of yours look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

8 You did very well. Now, put all of the things back into the envelope. Place the envelope on the floor under your chair.

9 Look at this group of animals. What are the animals in this group? That's right. There is a dog, a cat and a bird in this group. Why have we placed these animals together in a group? How are these animals alike? Do they all have four legs? No, because the bird does not have four legs. So, the number of legs they have does not make them alike. Could each of these animals be kept as a pet? Let's check each one and see.

10 Here is the dog. Could a dog be kept as a pet? If you said yes, you were right. A dog can be kept as a pet.

11 What about a cat? Could a cat be kept as a pet? Again if you said yes, you were right. A cat can be kept as a pet.

12 Think about this bird. Could a bird like this be kept as a pet? Yes, we could keep a bird like this as a pet.

9 Are all of the animals in this set pets? Is the dog a pet? Is the cat a pet? Is the bird a pet? Is that a good reason for putting all of these animals together in a group?

10 Here is a group you often see. What are the members of this group? Why are the boys members of this group? Why are the girls members of this group? Are the boys children? Are the girls children? Do we put these girls and boys together in a group because they are all children?

11 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "2" on it. Open it and put all the things on your desk. Find all of the members of the set of 6 animals and place them on the yellow piece of paper. Find all of the members of the set of 3 puppets and place them on the blue sheet of paper. Be careful. There are some things that do not belong in either set. Place the things that do not belong in either set back in the envelope.

12 Check your work. Does the work on your desk look like what is in the picture? If it does not look the same, change it so that it matches the picture.

13 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

13 Look at the members of this group. What are they? Why do we put these books together in a group? Are the books all the same color? No, they aren't the same color. So, that isn't the reason they are placed in a group.

14 Is the red book one of the members of the group? How is the red book similar to the other books?

S8 Is the green book similar to the other objects on the table?

S9 Let's take a closer look. Do you see the red book? Do you see the green book? How are all these things on the table top similar?

S8 Is this baby similar to the books on the table? Is this baby a member of the set of books. If you said no, you were right. The baby cannot be a member of the set of books because the baby is not a book.

S8 What do we have here in this group? How are all the balls similar? It's not the colors that make them alike. What is it that makes them alike?

S? Is this ball one of the balls in the group of balls? Why can we say this ball can be placed with the other balls?

S9 Now, find envelope number 3 beside your desk. Make three sets from the things you find in the envelope. Place the members of each of the three sets on a different piece of paper.

S10 Check your work. Are these the sets you found? There is one set of 3 cars, one set of 3 dolls, and one set of 3 blocks.

S9 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

S Here are many golf clubs. How are they similar? Why do you think we can place them all in one group? There are two types of golf clubs aren't there? Couldn't we place all the golf clubs made of wood together? Couldn't we place all the golf clubs made of iron together? Yes, we can also put all the golf clubs together - but why can we put them together?

S6 What are some of the foods you see here? How are these food items alike? Are all of these food items, fruit?

S? Is the apple a fruit? Is it one of the foods in the original group of food?

S0 Is the orange similar to the other foods in the group of foods? Is the orange a fruit?

S? Is the banana similar to the other foods from the group of foods? Is the banana a fruit?

S0 How about grapes? Is a grape a fruit? Is this food like the others in the group?

16 Let's think for a moment. Here are all the foods. How are they alike? Is each food a fruit?

33 Find envelope number 4 beside your desk. Open the envelope. Put the three sheets of paper on your desk. There is one blue sheet, one red sheet and one yellow sheet. Place the set of buttons on the blue sheet. Place the set of candles on the yellow sheet. Place the set of rocks on the red sheet.

113 Check your work. Did you do it correctly? If you did not, change yours to look the same as the picture.

53 You did very well. Now, put the papers and sets back in the envelope. Place the envelope on the floor under your chair.

50 Here's a fellow carrying something. What is he carrying? How are all of these objects alike? It isn't the color because all of the objects are a different color. What is the reason for putting all of these objects together in a group? Is the reason for putting these objects together in a group the fact that all of the members of the group are balloons? Let's check. Is the red object a balloon? Is the yellow object a balloon? What about the green object? Is the green object also a balloon?

38 Have you seen these before? Perhaps you have sometimes been sent to the store to buy some things for your mother. If you were, you probably had a set of coins in your pocket. Are all of the objects in this set coins? Let's check and see if the reason these objects are placed together in a group is the fact that they are all coins.

39 Is the nickel a coin? Is it similar to the other members of the group.

40 Is the dime a coin? Is it similar to the other coins? What, then, is the reason for placing all of these objects together in a group?

58 Find the envelope with the numeral five on it. Take the objects out and place them on your desk. There are two sheets of paper. One is green the other is red. Find all of the members of the set of spoons and place them on the red paper. Find all of the members of the set of sticks and place them on the green paper. Be careful. Some of the objects belong to neither set. Place these objects back in the envelope.

114 Check your work. Were you correct? Make your work look the same as the picture.

53 Good. You are learning very fast. Put the objects back in the envelope. Place the envelope on the floor under your chair.

737 This is a set of horses.

60 Is this cat a member of the set of horses? If you said no, you were right. A cat is not a horse. A cat cannot be a member of the set of horses.

43 Here's another group of objects. What are they?

53 If you had these pencils, you could draw and draw and draw.

43 How are all these pencils similar? We can see that the colors of the pencils are all different, so that can't be a reason. Why, then, can we group these pencils together?

44 What color pencil do we have here? Is it one of the pencils we saw in the group of pencils?

53 Find envelope number 6 on the floor beside your desk. Open it. Place the three sheets of paper on your desk. Make three sets from the objects you find in the envelope. Put the members of each of the three sets on separate pieces of paper.

116 Are these the sets you found? There is a set of fruit. There is a set of jacks. There is a set of crayons.

53 You are doing very well. Keep up the good work. Put all of the things on your desk into the envelope. Place the envelope on the floor under your chair.

1 Today we have talked about groups of things. We found out that similar things, or objects that are alike can be grouped together only if they have something in common. For example, we talked about the set of balloons. All the members belonged to the set because they were balloons. An airplane is not a balloon, so we couldn't place it in the same set. Can you think of a set? I'll see you tomorrow when we'll do some more exploring in Mr. Mathematics' basket of sets. Good-bye for now.

LESSON ONE:
INDUCTIVE-VARIED NON-MANIPULATIVE
INTRODUCTION TO SETS

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6 You may have seen these before on the playground. What are they? Why do we place the two swings together? Do we use the two swings for the same purpose?

7 Here is one of the swings. How do we use this swing? Do we swing in the swing?

6 Here is the group of swings. Do we use <u>both</u> swings for the same purpose?

53 Beside your desk is a large envelope with the numeral one on it. Open the envelope. Take out the piece of paper and crayons. Color the members of the set of dishes red. Color the members of the set of blocks green. Color the members of the set of money yellow.

107 Check your work. Do your three sets look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

53 You did very well, Put all of the things back into the envelope. Place the envelope on the floor under your chair.

9 Look at this group of animals. What are the animals in this group? That's right. There is a dog, a cat and a bird in this group. Why have we placed these animals together in a group? How are these animals alike? Do they all have four legs? No, because the bird does not have four legs. So, the number of legs they have does not make them alike. Could each of these animals be kept as a pet? Let's check each one and see.

10 Here is the dog. Could a dog be kept as a pet? If you said yes, you were right. A dog can be kept as a pet.

11 What about a cat? Could a cat be kept as a pet? Again if you said yes, you were right. A cat can be kept as a pet.

12 Think about this bird. Could a bird like this be kept as a pet? Yes, we could keep a bird like this as a pet.

9 Are all of the animals in this set pets? Is the dog a pet? Is the cat a pet? Is the bird a pet? Is that a good reason for putting all of these animals together in a group?

198 Here is a group you often see. What are the members of this group? Why are the boys members of this group? Why are the girls members of this group? Are the boys children? Are the girls children? Do we put these girls and boys together in a group because they are all children?

33 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "2" on it. Open it and put all of the things on your desk. One piece of paper has pictures of many different things. Pick out all of the members of the set of animals and color them yellow. Pick out all of the members of the set of puppets and color them blue. Do not color the things on the paper that do not belong to either set.

109 Check your work. Does the work you have completed on your desk look the same as the picture. If it does not, change your work so that they match.

33 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

33 Look at the members of this group. What are they? Why do we put these books together in a group? Are the books all the same color? No, they aren't the same color. So, that isn't the reason they are placed in a group.

34 Is the red book one of the members of the group? How is the red book similar to the other books?

35 Is the green book similar to the other objects on the table?

39 Let's take a close look. Do you see the red book? Do you see the green book? How are all these things on the table top similar?

56 Is this baby similar to the books on the table? Is this baby a member of the set of books. If you said no, you were right. The baby cannot be a member of the set of books because the baby is not a book.

64 What do we have here in this group? How are all the balls similar? It's not the colors that make them alike. What is it that makes them alike?

67 Is this ball one of the balls in the group of balls? Why can we say that this ball can be placed with the other balls?

83 Now, find envelope number 3 beside your desk. Make three sets. Put an "X" on the members of one set. Put an "A" on the members of one set. Put an "O" on the members of one set.

111 Did you find sets like these? There is one set of 3 cars, one set of 3 dolls, and one set of 3 blocks.

53 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

3 Here are many golf clubs. How are they similar? Why do you think we can place them all in one group? There are two types of golf clubs aren't there? Couldn't we place all the golf clubs made of wood together? Couldn't we place all the golf clubs made of iron together? Yes, we can also put all the golf clubs together -- but why can we put them together?

16 What are some of the foods you see here? Are all of these food items fruit? How are these food items alike?

17 Is the apple a fruit? Is it one of the foods in the original group of food?

18 Is the orange similar to the other foods in the group of foods? Is the orange a fruit?

19 Is the banana similar to the other foods from the group of foods? Is the banana a fruit?

29 Now about grapes? Is a grape a fruit? Is this food like the others in the group?

36 Let's think for a moment. Here are all the foods. How are they alike? Is each food a fruit?

53 Find envelope number 4 beside your desk. Open the envelope. Find the paper and three crayons and place them on your desk. There is one red crayon, one yellow crayon, and one blue crayon. Color the members of the set of buttons, red. Color the members of the set of candles, yellow. Color the members of the set of rocks, blue.

113 Check your work. Did you do it correctly? If you did not, change it so that it is correct. Make yours look the same as the picture.

53 You did very well. Now, put the crayons and paper back into the envelope. Place the envelope on the floor under your chair.

30 Here's a fellow carrying something. What is he carrying? How are all of these objects alike? It isn't the color because all of the objects are a different color. What is the reason for putting all of these objects together in a group? Is the reason for putting these objects together in a group the fact that all of the members of the group are balloons? Let's check. Is the red object a balloon? Is the yellow object a balloon? What about the green object? Is the green object also a balloon?

38 Have you seen these before? Perhaps you have sometimes been sent to the store to buy some things for your mother. If you were, you probably had a set of coins in your pocket. Are all of the objects in this set coins? Let's check and see if the reason these objects are placed together in a group is the fact that they are all coins.

39 Is the nickel a coin? Is it similar to the other members of the group?

40 Is the dime a coin? Is it similar to the other coins? What, then, is the reason for placing all of these objects together in a group?

53 Find the envelope on the floor with the number 5 on it. Take the paper and crayons out and place them on your desk. Look at the pictures on the paper. Find all of the members of the set of spoons and color them red. Find all of the members of the set of sticks and color them green. Be careful. Some of the objects do not belong to either set. Do not color these objects.

110 Check your work. Did you do it correctly? If your work does not match the picture, change it so that it does.

53 Good. You are learning very fast. Put your paper and crayons back in the envelope. Place the envelope on the floor under your chair.

727 This is a set of horses.

60 Is this cat a member of the set of horses? If you said no, you were right. A cat is not a horse. A cat cannot be a member of the set of horses.

40 Here's another group of objects. What are they?

53 If you had these pencils, you could draw and draw and draw.

63 How are all these pencils similar? We can see that the colors of the pencils are all different, so that can't be a reason. Why, then, can we group these pencils together?

64 What color pencil do we have here? Is it one of the pencils we see in the group of pencils?

53 Find the envelope with the number 6 on it on the floor beside your desk. Open it. Place the paper and pencil on your desk. Find three sets. Put 'A's' on the members of one set. Put 'L's' on the members of one set. Put 'O's' on the members of one set.

117 Did you find three sets? There is a set of jobs. There is a set of crayons. There is a set of fruit.

53 You are doing very well. Keep up the good work. Put all of the things on your desk back into the envelope. Place the envelope on the floor under your chair.

1 Today we have talked about groups of things. We found out that similar things, or objects that are alike can be grouped together only if they have something in common. For example, we talked about the set of balloons. All the members belonged to the set because they were balloons. An airplane is not a balloon, so we couldn't place it in the same set. Can you think of a set? I'll see you tomorrow when we'll do some more exploring in Mr. Mathematics' basket of sets. Good-bye for now.

LESSON ONE:
INDUCTIVE-EXACT MANIPULATIVE
INTRODUCTION TO SETS

1 Hello! I want you to meet Mr. Mathematics. He's going to help me show you some things about mathematics which you may not have learned before. As you can see, he has three baskets of mathematics: numbers, shapes, and sets. In Mr. Mathematics' first basket are numbers. You probably know about this kind of mathematics. Sometimes we call this kind arithmetic. There are two other kinds of mathematics you may not know about. In Mr. Mathematics' second basket are shapes. In Mr. Mathematics' third basket are sets. We'll be studying numbers, shapes, and sets. Today we are going to talk about things you often see grouped together. Let's find out why we group some things together.

2 We often see dishes on a breakfast table. Are these dishes alike in any way? We can see that all the dishes are the same color, but is color the best reason for putting them together in a group? Are the bowls, dishes? Are the cups, dishes? Are the plates, dishes? What is the best reason for putting the plates, the cups and the bowls together in a group?

6 You may have seen these before on the playground. What are they? Why do we place the two swings together? Do we use the two swings for the same purpose?

7 Here is one of the swings. How do we use this swing? Do we swing in the swing?

6 Here is the group of swings. Do we use both swings for the same purpose?

10 Beside your desk is a large envelope with the numeral one on it. Open the envelope. Put the three sheets of paper on your desk. There is one green sheet, one red sheet and one yellow sheet. Place the set of blocks on the green sheet. Place the set of dishes on the red sheet. Place the set of money on the yellow sheet.

10b Check your work. Do the three sets of yours look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

11 You did very well. Now, put all of the things back into the envelope. Place the envelope on the floor under your chair.

9 Look at this group of animals. What are the animals in this group? That's right. There is a dog, a cat and a bird in this group. Why have we placed these animals together in a group? How are these animals alike? Do they all have four legs? No, because the bird does not have four legs. So, the number of legs they have does not make them alike. Could each of these animals be kept as a pet. Let's check each one and see.

10 Here is the dog. Could a dog be kept as a pet? If you said yes, you were right. A dog can be kept as a pet.

11 What about a cat? Could a cat be kept as a pet? Again if you said yes, you were right. A cat can be kept as a pet.

12 Think about this bird. Could a bird like this be kept as a pet? Yes, we could keep a bird like this as a pet.

9 Are all of the animals in this set pets? Is the dog a pet? Is the cat a pet? Is the bird a pet? Is that a good reason for putting all of these animals together in a group?

190 Here is a group you often see. What are the members of this group? Why are the boys members of this group? Why are the girls members of this group? Are the boys children? Are the girls children? Do we put those girls and boys together in a group because they are all children?

53 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "2" on it. Open it and put all the things on your desk. Find all of the members of the set of 6 animals and place them on the yellow piece of paper. Find all of the members of the set of 3 puppets and place them on the blue sheet of paper. Be careful. There are some things that do not belong in either set. Place the things that do not belong in either set back in the envelope.

100 Check your work. Does the work on your desk look like what is in the picture? If it does not look the same, change it so that it matches the picture.

53 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

33 Look at the members of this group. What are they? Why do we put these books together in a group? Are the books all the same color? No, they aren't the same color. So, that isn't the reason they are placed in a group.

56 Is the red book one of the members of the group? How is the red book similar to the other books?

10 Is the green book similar to the other objects on the table?

11 Let's take a close look. Do you see the red book? Do you see the green book? Now are all these things on the table top similar?

12 Is this baby similar to the books on the table? Is this baby a member of the set of books. If you said no, you were right. The baby cannot be a member of the set of books because the baby is not a book.

13 What do we have here in this group? Now are all the balls similar? It's not the colors that make them alike. What is it that makes them alike?

14 Is this ball one of the balls in the group of balls? Why can we say that this ball can be placed with the other balls?

15 Now, find envelope number 3 beside your desk. Make three sets from the things you find in the envelope. Place the members of each of the three sets on a different piece of paper.

16 Check your work. Are these the sets you found? There is one set of 3 cars, one set of 3 dolls, and one set of 3 blocks.

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10 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "1" on it. Open it and put all the things on your desk. Find all of the members of the set of 4 animals and place them on the yellow piece of paper. Find all of the members of the set of 3 puppets and place them on the blue sheet of paper. Be careful. There are some things that do not belong in either set. Place the things that do not belong in either set back in the envelope.

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SI Inside your desk is a large envelope with the numeral one on it. Open the envelope. Take out the piece of paper and crayons. Color the members of the set of dishes red. Color the members of the set of blocks green. Color the members of the set of money yellow.

IST Check your work. Do your three sets look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

SI You did very well. Put all of the things back into the envelope. Place the envelope on the floor under your chair.

9 Look at this group of animals. What are the animals in this group? That's right. There is a dog, a cat and a bird in this group. Why have we placed these animals together in a group? How are these animals alike? Do they all have four legs? No, because the bird does not have four legs. So, the number of legs they have does not make them alike. Could each of these animals be kept as a pet? Let's check each one and see.

10 Here is the dog. Could a dog be kept as a pet? If you said yes, you were right. A dog can be kept as a pet.

11 What about a cat? Could a cat be kept as a pet? Again if you said yes, you were right. A cat can be kept as a pet.

12 Think about this bird. Could a bird like this be kept as a pet? Yes, we could keep a bird like this as a pet.

9 Are all of the animals in this set pets? Is the dog a pet? Is the cat a pet? Is the bird a pet? Is that a good reason for putting all of these animals together in a group?

10 Here is a group you often see. What are the members of this group? Why are the boys members of this group? Why are the girls members of this group? Are the boys children? Are the girls children? Do we put these girls and boys together in a group because they are all children?

11 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the number 1 on it. Open it and put all of the things on your desk. One piece of paper has pictures of many different things. Pick out all of the members of the set of animals and color them yellow. Pick out all of the members of the set of puppets and color them blue. Do not color the things on the paper that do not belong to either set.

12 Check your work. Does the work you have completed on your desk look the same as the picture. If it does not, change your work so that they match.

13 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

13 Look at the members of this group. What are they? Why do we put these books together in a group? Are the books all the same color? No, they aren't the same color. So, that isn't the reason they are placed in a group.

96 Is the red book one of the members of the group? How is the red book similar to the other books?

97 Is the green book similar to the other objects on the table?

98 Let's take a close look. Do you see the red book? Do you see the green book? How are all these things on the table top similar?

99 Is this baby similar to the books on the table? Is this baby a member of the set of books. If you said no, you were right. The baby cannot be a member of the set of books because the baby is not a book.

100 What do we have here in this group? How are all the balls similar? It's not the colors that make them alike. What is it that makes them alike?

101 Is this ball one of the balls in the group of balls? Why can we say that this ball can be placed with the other balls?

102 Now, find envelope number 3 beside your desk. Take these cats. Put an "A" on the members of one set. Put an "B" on the members of one set. Put an "C" on the members of one set.

111 Did you find sets like these? There is one set of 3 cars, one set of 3 dolls, and one set of 3 bicycles.

112 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

1 We often use dishes on a breakfast table. Are these dishes alike in any way? We can see that all the dishes are the same color, but is color the best reason for putting them together in a group? Are the bowls, dishes? Are the cups, dishes? Are the plates, dishes? What is the best reason for putting the plates, the cups and the bowls together in a group?

6 You may have seen these before on the playground. What are they? Why do we place the two swings together? Do we use the two swings for the same purpose?

7 Here is one of the swings. How do we use this swing? Do we swing in the swing?

8 Here is the group of swings. Do we use both swings for the same purpose?

S1 Beside your desk is a large envelope with the numeral one (1) on it. Open the envelope. Take out the piece of paper and crayons. Color the members of the set of dishes red. Color the members of the set of blocks green. Color the members of the set of money yellow.

S2 Check your work. Do your three sets look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

S3 You did very well. Put all of the things back into the envelope. Place the envelope on the floor under your chair.

T Look at this group of animals. What are the animals in this group? That's right. There is a dog, a cat and a bird in this group. Why have we placed these animals together in a group? How are these animals alike? Do they all have four legs? No, because the bird does not have four legs. So, the number of legs they have does not make them alike. Could each of these animals be kept as a pet? Let's check each one and see.

S4 Here is the dog. Could a dog be kept as a pet? If you said yes, you were right. A dog can be kept as a pet.

S5 What about a cat? Could a cat be kept as a pet? Again if you said yes, you were right. A cat can be kept as a pet.

S6 Think about this bird. Could a bird like this be kept as a pet? Yes, we could keep a bird like this as a pet.

T Are all of the animals in this set pets? Is the dog a pet? Is the cat a pet? Is the bird a pet? Is that a good reason for putting all of these animals together in a group?

S7 Here is a group you often see. What are the members of this group? Why are the boys members of this group? Why are the girls members of this group? Are the boys children? Are the girls children? So we put these girls and boys together in a group because they are all children?

S8 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "2" on it. Open it and put all of the things on your desk. One piece of paper has pictures of many different things. Pick out all of the members of the set of animals and color them yellow. Pick out all of the members of the set of puppets and color them blue. Do not color the things on the paper that do not belong to either set.

JIM Check your work. Does the work you have completed on your desk look the same as the picture. If it does not, change your work so that they match.

SS You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

SS Look at the members of this group. What are they? Why do we put these books together in a group? Are the books all the same color? No, they aren't the same color. So, that isn't the reason they are placed in a group.

SS Is the red book one of the members of the group? How is the red book similar to the other books?

SS Is the green book similar to the other objects on the table?

SS Let's take a closer look. Do you see the red book? Do you see the green book? How are all these things on the table the similar?

SS Is this baby similar to the books on the table? Is this baby a member of the set of books. If you said no, you were right. The baby cannot be a member of the set of books because the baby is not a book.

SS What do we have here in this group? How are all the balls similar? It's not the colors that make them alike. What is it that makes them alike?

SS Is this ball one of the balls in the group of balls? Why can we say that this ball can be placed with the other balls?

SS Now, find envelope number 3 beside your desk. Take three sets. Put an "S" on the members of one set. Put an "S" on the members of one set. Put an "S" on the members of one set.

III Did you find sets like these? There is one set of 3 shoes, one set of 3 dolls, and one set of 3 blocks.

SS Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

I Today we have talked about groups of things. We found out that similar things, or objects that are alike can be grouped together only if they have something in common. For example, we talked about the set of balloons. All the members belonged to the set because they were balloons. An airplane is not a balloon, so we couldn't place it in the same set. Can you think of a set? I'll see you tomorrow when we'll do some more exploring in Mr. Mathematics' basket of sets. Good-bye for now.

LESSON ONE:
[illegible]
INTRODUCTION TO SETS

I Hello! I want you to meet Mr. Mathematics. He's going to help me show you some things about mathematics which you may not have learned before. As you can see, he has three baskets of mathematics: numbers, shapes, and sets. In Mr. Mathematics' first basket are numbers. You probably know about this kind of mathematics. Sometimes we call this kind, arithmetic. There are two other kinds of mathematics in his basket. In Mr. Mathematics' second basket are shapes. In Mr. Mathematics' third basket are sets. We'll be exploring the mathematics in each of Mr. Mathematics' baskets. We'll be studying numbers, shapes, and sets.

Today we are going to talk about some of the sets which you see every day. But what is a set? A set is a group of things which go together. We call these things in a set, members of the set.

2 Here is a set you may have seen on the breakfast table this morning. This is a set of dishes. The things in this set go together because they are all dishes. Every member of this set is a dish. The members of this set are two large plates, two small plates, two bowls and two cups. This is a set of dishes.

6 Here is another set you may have seen recently. You may have seen a set like this on the playground. Have you ever swung on a swing? This is a set of swings. Every member of this set is a swing. You can swing on every member of this set.

7 This is one member of the set of swings. You can swing on this set member. Every member of this set is a swing. You can swing on every member of this set.

10 Beside your desk is a large envelope with the numeral one on it. Open the envelope. Put the three sheets of paper on your desk. There is one green sheet, one red sheet and one yellow sheet. Place the set of birds on the green sheet. Place the set of dishes on the red sheet. Place the set of swings on the yellow sheet.

[illegible] Check your work. Do the three sets of yours look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

13 You did very well. Now, put all of the things back into the envelope. Place the envelope on the floor under your chair.

04 Have you ever had a pet?

05 This set of pets has in it a dog, a cat, and a bird. The pets in this set are each a different color. The dog is brown. The cat is white and the bird is green. But the reason these animals are members of the set is because they are all pets.

06 The dog is a pet. Therefore, he is a member of the set of pets.

07 The cat is also a member of the set because he is a pet.

08 The bird is also a member of the set because he is a pet.

09 The dog, the cat, and the bird make up the set of pets. Every member of the set of pets is a pet.

10 Another set which you see every day is the set of boys. There are sets of boys in your classroom, aren't there? This set of boys has five members. Each boy has a different colored shirt. All of these boys are members of the set. They are all members of this set because they are all boys. A girl could not be a member of this set. Only boys can be members of this set. This is a set of boys.

11 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "3" on it. Open it and get all the things on your desk. Find all of the members of the set of 6 animals and place them on the yellow piece of paper. Find all of the members of the set of 3 puppets and place them on the blue sheet of paper. Be careful. There are some things that do not belong to either set. Place the things that do not belong to either set back in the envelope.

12 Check your work. Does the work on your desk look like what is in the picture? If it does not look the same, change it so that it matches the picture.

13 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

14 You probably see this set today in your classroom. This is a set of books. Each of these books is a different color, but you can read every member of this set.

15 You can read the red book. The red book is a member of the set. Any book could be a member of this set.

68 This green book is also a member of the set of books. You can read this green book.

69 All of the books on this table are members of the set. This is a set of books.

70 This baby would not be a member of the set of books. Only books can be members of this set.

71 The set we are going to talk about now is the set of balls. Each ball is a different color. You can bounce every member of this set. You can roll every member of this set, and you can throw every member of this set.

72 Here is one member of the set of balls. You can bounce this ball. You can roll this ball and you can throw this ball. This ball is a member of the set of balls.

73 Now find envelope number 3 beside your desk. Take these cards from the things you find in the envelope. Place the members of each of the three sets on a different piece of paper.

(146) Check your work. Are these the sets you found? There is one set of 3 cups, one set of 3 dolls, and one set of 3 trucks.

74 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

75 Here is a set of golf clubs. Have you ever played golf? I play sometimes. Sometimes I watch other people play golf on television. You could use this set to play golf. The members of this set go together because they are all used to play golf. They are all golf clubs. Some of the members of the set are called irons, because they are made out of iron. Some of the members of this set are called woods, because they are made out of wood. But all of the woods and all of the irons are members of the set because they are all golf clubs. All of these golf clubs together as a group make up the set of golf clubs.

76 This set will make you hungry. You may have seen this set at lunch time. This set of foods has an the members an apple, an orange, a banana, and a bunch of grapes. You can eat every member of this set.

77 You can eat an apple. The apple is a member of the set of foods.

78 You can eat an orange. The orange is a member of the set of foods.

19 You can set a banana. The banana is a member of the set of fruits.

20 You can set grapes. This bunch of grapes is also a member of the set of fruits.

21 The apple, the orange, the banana, and the bunch of grapes are all members of the set because they are all pieces of fruit.

22 Find envelope number 6 beside your desk. Open the envelope. Put the three sheets of paper on your desk. There is one blue sheet, one red sheet and one yellow sheet. Place the set of buttons on the blue sheet. Place the set of crayons on the yellow sheet. Place the set of coins on the red sheet.

23 Check your work. Did you do it correctly? If you did not, change yours to look the same as the picture.

24 You did very well. Now, put the pieces and sets back in the envelope. Place the envelope on the floor under your chair.

25 Now you are looking at a set of balloons. All of the balloons together is a group made up the set of balloons. Have you ever had a balloon? This toy has lots of balloons. Each balloon that he is holding is a member of the set. All of the balloons make up his set of balloons.

26 This time the things we are going to talk about are coins. Have you ever been sent to the store to do some shopping? If you did, you probably had a set of coins in your pocket. The coins in this set are a fifty-cent piece, a quarter or a twenty-five cent piece, ten dime, a nickel, and three pennies. Each coin is one member of the set. Every member of the set is a coin. All of the coins together is a group make up the set of coins. You can see the different members of this set.

27 Here is a nickel. The nickel is a coin. Therefore, the nickel is a member of the set of coins.

28 Here is a dime. The dime is also a coin. Therefore, the dime is a member of the set of coins.

29 Find the envelope with the numeral five on it. Take the objects out and place them on your desk. There are two sheets of paper. One is green the other is red. Find all of the members of the set of crayons and place them on the red paper. Find all of the members of the set of sticks and place them on the green paper. As overall, some of the objects belong to neither set. Place those objects back in the envelope.

LIZ Check your work. Were you correct? Make your work look the same as the picture.

GS Good. You are learning very fast. Put the objects back in the envelope. Place the envelope on the floor under your chair.

TOT This is a set of bones.

GS Is this set a member of the set of bones?

GS There is a set of pretty colored pencils. If you had these pencils you could draw and draw and draw. Every member of this set is a different color. Every member of this set is a pencil. Each pencil is one member of the set.

GS Here is one member of the set of pencils. There are lots of other members in the set of pencils. Can you think of one? Remember, all of the members of this set are pencils. Would a pen be a member of the set of pencils? Think about it.

GS Find envelope number 6 on the floor beside your desk. Open it. Place the three sheets of paper on your desk. Make three sets from the objects you find in the envelope. Put the members of each of the three sets on separate pieces of paper.

LIZ Are these the sets you found? There is a set of fruits. There is a set of jacks. There is a set of crayons.

GS You are doing very well. Keep up the good work. Put all of the things on your desk into the envelope. Place the envelope on the floor under your chair.

S Good-bye for now. I'll see you tomorrow and we'll do some more exploring in the basket of sets.

LESSON TWO:
SOME [illegible] AND NON-MEMBERS
[illegible] OF SETS

I Hello! I want you to meet Mr. Mathematics. He's going to help me show you some things about mathematics which you may not have learned before. As you can see, he has three baskets of mathematics: numbers, shapes, and sets. In Mr. Mathematics' first basket are numbers. You probably know about this kind of mathematics. Sometimes we call this kind, arithmetic. There are two other kinds of mathematics in his basket. In Mr. Mathematic's second basket are shapes. In Mr. Mathematic's third basket are sets. We'll be exploring the mathematics in each of Mr. Mathematics' baskets. We'll be studying numbers, shapes and sets.

Today we are going to talk about some of the sets which you see every day. But what is a set? A set is a group of things which go together. We call those things in a set, members of the set.

I Here is a set you may have seen on the breakfast table this morning. This is a set of dishes. The things in this set go together because they are all dishes. Every member of this set is a dish. The members of this set are two large plates, two small plates, two bowls and two cups. This is a set of dishes.

I. Here is another set you may have seen recently. You may have seen a set like this on the playground. Have you ever swung on a swing? This is a set of swings. Every member of this set is a swing. You can swing on every member of this set.

I This is one member of the set of swings. You can swing on this set member. Every member of this set is a swing. You can swing on every member of this set.

II Inside your desk is a large envelope with the numeral one on it. Open the envelope. Take out the piece of paper and crayons. Color the members of the set of dishes red. Color the members of the set of blocks green. Color the members of the set of sheep yellow.

III Check your work. Do your three sets look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

IV You did very well. Put all of the things back into the envelope. Place the envelope on the floor under your chair.

V Have you ever had a pet?

0 This set of pets has in it a dog, a cat, and a bird. The pets in this set are each a different color. The dog is brown. The cat is white and the bird is green. But the reason these animals are members of the set is because they are all pets.

10 The dog is a pet. Therefore, he is a member of the set of pets.

11 The cat is also a member of the set because he is a pet.

12 The bird is also a member of the set because he is a pet.

0 The dog, the cat, and the bird make up the set of pets. Every member of the set of pets is a pet.

01 Another set which you see every day is the set of boys. There are sets of boys in your classroom, aren't there? This set of boys has five members of the set. They are all members of this set because they are all boys. A girl could not be a member of this set. Only boys can be members of this set. This is a set of boys.

02 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the number "2" on it. Open it and put all of the things on your desk. One piece of paper has pictures of many different things. Pick out all of the members of the set of animals and color them yellow. Pick out all of the members of the set of puppets and color them blue. Do not color the things on the paper that do not belong to either set.

203 Check your work. Does the work you have completed on your desk look the same as the picture. If it does not, change your work so that they match.

10 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

10 You probably saw this set today in your classroom. This is a set of books. Each of these books is a different color, but you can read every member of this set.

10 You can read the red book. The red book is a member of the set. Any book could be a member of this set.

10 This green book is also a member of the set of books. You can read this green book.

10 All of the books on this table are members of the set. This is a set of books.

58 This lady would not be a member of the set of books. Only books can be members of this set.

60 The set we are going to talk about now is the set of balls. Each ball is a different color. You can bounce every member of this set. You can roll every member of this set, and you can throw every member of this set.

61 Here is one member of the set of balls. You can bounce this ball. You can roll this ball and you can throw this ball. This ball is a member of the set of balls.

62 Now, find envelope number 3 beside your desk. Make three sets. Put an "X" on the members of one set. Put an "X" on the members of one set. Put an "X" on the members of one set.

111 Did you find sets like these? There is one set of 3 cars, one set of 3 dolls, and one set of 3 books.

63 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

8 Here is a set of golf clubs. Have you ever played golf? I play sometimes. Sometimes I watch other people play golf on television. You could use this set to play golf. The members of this set go together because they are all used to play golf. They are all golf clubs. Some of the members of the set are called irons, because they are made out of iron. Some of the members of this set are called woods, because they are made out of wood. But all of the woods and all of the irons are members of the set because they are all golf clubs. All of these golf clubs together in a group make up the set of golf clubs.

16 This set will make you hungry. You may have seen this set at lunch time. This set of fruits has as its members an apple, an orange, a banana and a bunch of grapes. You can eat every member of this set.

17 You can eat an apple. The apple is a member of the set of fruits.

18 You can eat an orange. The orange is a member of the set of fruits.

19 You can eat a banana. The banana is a member of the set of fruits.

20 You can eat grapes. ~~This~~ bunch of grapes is also a member of the set of fruits.

111

26 The apple, the orange, the banana, and the bunch of grapes are all members of the set because they are all pieces of fruit.

27 Find envelope number 6 beside your desk. Open the envelope. Find the paper and three crayons and place them on your desk. There is one red crayon, one yellow crayon and one blue crayon. Color the members of the set of buttons, red. Color the members of the set of cookies, yellow. Color the members of the set of rocks, blue.

110 Check your work. Did you do it correctly? If you did not, change it so that it is correct. Make yours look the same as the pictures.

28 You did very well. Now, put the crayons and paper back into the envelope. Place the envelope on the floor under your chair.

29 Now you are looking at a set of balloons. All of the balloons together in a group make up the set of balloons. Have you ever had a balloon? This toy has lots of balloons. Each balloon that he is holding is a member of the set. All of the balloons make up the set of balloons.

30 This time the things we are going to talk about are coins. Have you ever been out to the store to do some shopping? If you did, you probably had a set of coins in your pocket. The coins in this set are a fifty-cent piece, a quarter or a twenty-five cent piece, two dimes, a nickel, and three pennies. Each coin is one member of the set. Every member of the set is a coin. All of the coins together in a group make up the set of coins. You can see the different members of this set.

31 Here is a nickel. The nickel is a coin. Therefore, the nickel is a member of the set of coins.

32 Here is a dime. The dime is also a coin. Therefore, the dime is a member of the set of coins.

33 Find the envelope on the floor with the numeral 5 on it. Take the paper and crayons out and place them on your desk. Look at the pictures on the paper. Find all of the members of the set of spoons and color them red. Find all of the members of the set of sticks and color them green. Be careful. Some of the objects do not belong to either set. Do not color these objects.

111 Check your work. Did you do it correctly? If your work does not match the picture, change it so that it does.

34 Good. You are learning very fast. Put your paper and crayons back in the envelope. Place the envelope on the floor under your chair.

go

TIP This is a set of boxes.

QU Is this set a member of the set of boxes?

CO Here is a set of pretty colored pencils. If you had these pencils you could draw and draw and draw. Every member of this set is a different color. Every member of this set is a pencil. Each pencil is one member of the set.

QU Here is one member of the set of pencils. There are lots of other members in the set of pencils. Can you think of one? Remember, all of the members of this set are pencils. Would a pen be a member of the set of pencils? Think about it.

CO Find the envelope with the number 4 on it on the floor beside your desk. Open it. Place the paper and pencil on your desk. Find three sets. Put A's on the members of one set. Put B's on the members of one set. Put C's on the members of one set.

TIP Did you find these sets? There is a set of jacks. There is a set of crayons. There is a set of fruit.

CO You are doing very well. Keep up the good work. Put all of the things on your desk back into the envelope. Place the envelope on the floor under your chair.

S Good-bye for now. I'll see you tomorrow and we'll do some more exploring in the basket of sets.

LESSON ONE:
SUBSCRIPT-CHART MANIPULATIVE
INTRODUCTION TO SETS

1 Hello! I want you to meet Mr. Mathematics'. He's going to help me show you some things about mathematics which you may not have learned before. As you can see, he has three baskets of mathematics: numbers, shapes, and sets. In Mr. Mathematics' first basket are numbers. You probably know about this kind of mathematics. Sometimes we call this kind, arithmetic. There are two other kinds of mathematics in his basket. In Mr. Mathematics' second basket are shapes. In Mr. Mathematics' third basket are sets. We'll be exploring the mathematics in each of Mr. Mathematics' baskets. We'll be studying numbers, shapes and sets.

Today we are going to talk about some of the sets which you see every day. But what is a set? A set is a group of things which go together. We call these things in a set, members of the set.

2 Here is a set you may have seen on the breakfast table this morning. This is a set of dishes. The things in this set go together because they are all dishes. Every member of this set is a dish. The members of this set are two large plates, two small plates, two bowls and two cups. This is a set of dishes.

4 Here is another set you may have seen recently. You may have seen a set like this on the playground. Have you ever swung on a swing? This is a set of swings. Every member of this set is a swing. You can swing on every member of this set.

7 This is one member of the set of swings. You can swing on this set member. Every member of this set is a swing. You can swing on every member of this set.

33 Beside your desk is a large envelope with the numeral one on it. Open the envelope. Put the three sheets of paper on your desk. There is one green sheet, one red sheet and one yellow sheet. Place the set of blocks on the green sheet. Place the set of dishes on the red sheet. Place the set of money on the yellow sheet.

100 Check your work. Do the three sets of yours look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

33 You did very well. Now, put all of the things back into the envelope. Place the envelope on the floor under your chair.

56 Have you ever had a pet?

0 This set of pets has in it a dog, a cat, and a bird. The pets in this set are each a different color. The dog is brown. The cat is white and the bird is green. All the reasons these animals are members of the set is because they are all pets.

10 The dog is a pet. Therefore, he is a member of the set of pets.

11 The cat is also a member of the set because he is a pet.

12 The bird is also a member of the set because he is a pet.

0 The dog, the cat, and the bird make up the set of pets. Every member of the set of pets is a pet.

56 Another set which you see every day is the set of boys. There are sets of boys in your classroom, aren't there? This set of boys has five members. Each boy has a different colored shirt. All of these boys are members of the set. They are all members of this set because they are all boys. A girl could not be a member of this set. Only boys can be members of this set. This is a set of boys.

10 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "2" on it. Open it and put all the things on your desk. Find all of the members of the set of 3 puppets and place them on the blue sheet of paper. Be careful. There are some things that do not belong in either set. Place the things that do not belong in either set back in the envelope.

100 Check your work. Does the work on your desk look like what is in the picture? If it does not look the same, change it so that it matches the picture.

10 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

10 You probably see this set today in your classroom. This is a set of books. Each of these books is a different color, but you can count every member of this set.

56 You can count the red book. The red book is a member of the set. Any book could be a member of this set.

10 This green book is also a member of the set of books. You can count this green book.

00 All of the books on this table are members of the set. This is a set of books.

00 This baby could not be a member of the set of books. Only books can be members of this set.

00 The set we are going to talk about now is the set of balls. Each ball is a different color. You can bounce every member of this set. You can roll every member of this set, and you can throw every member of this set.

07 Here is one member of the set of balls. You can bounce this ball. You can roll this ball and you can throw this ball. This ball is a member of the set of balls.

10 Now, find envelope number 1 beside your desk. Take three sets from the things you find in the envelope. Place the members of each of the three sets on a different piece of paper.

110 Check your work. Are these the sets you found? There is one set of 5 cars, one set of 5 dolls, and one set of 5 blocks.

00 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

1 Here is a set you may have seen on the breakfast table this morning. This is a set of dishes. The things in this set go together because they are all dishes. Every member of this set is a dish. The members of this set are two large plates, two small plates, two bowls and two cups. This is a set of dishes.

6 Here is another set you may have seen recently. You may have seen a set like this on the playground. Have you ever swung on a swing? This is a set of swings. Every member of this set is a swing. You can swing on every member of this set.

7 This is one member of the set of swings. You can swing on this set better. Every member of this set is a swing. You can swing on every member of this set.

10 Beside your desk is a large envelope with the number one on it. Open the envelope. Put the three sheets of paper on your desk. There is one green sheet, one red sheet and one yellow sheet. Place the set of blocks on the green sheet. Place the set of dishes on the red sheet. Place the set of money on the yellow sheet.

100 Check your work. Do the three sets of pegs look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

99 You did very well. Now, put all of the things back into the envelope. Place the envelope on the floor under your chair.

98 Have you ever had a pet?

9 This set of pets has in it a dog, a cat, and a bird. The pets in this set are each a different color. The dog is brown. The cat is white and the bird is green. But the reason these animals are members of the set is because they are all pets.

97 The dog is a pet. Therefore, he is a member of the set of pets.

11 The cat is also a member of the set because he is a pet.

12 The bird is also a member of the set because he is a pet.

9 The dog, the cat, and the bird make up the set of pets. Every member of the set of pets is a pet.

13 Another set which you see every day is the set of boys. There are sets of boys in your classroom, aren't there? This set of boys has five members. Each boy has a different colored shirt. All of these boys are members of the set. They are all members of this set because they are all boys. A girl could not be a member of this set. Only boys can be members of this set. This is a set of boys.

93 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "2" on it. Open it and put all the things on your desk. Find all of the members of the set of 4 animals and place them on the yellow piece of paper. Find all of the members of the set of 3 puppets and place them on the blue sheet of paper. Be careful. There are some things that do not belong in either set. Place the things that do not belong in either set back in the envelope.

100 Check your work. Does the work on your desk look like what is in the picture? If it does not look the same, change it so that it matches the picture.

95 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

to

04 You probably see this set today in your classroom. This is a set of books. Each of these books is a different color, but you can count every member of this set.

05 You can count the red book. The red book is a member of the set. Any book could be a member of this set.

06 This green book is also a member of the set of books. You can count this green book.

07 All of the books on this table are members of the set. This is a set of books.

08 This baby would not be a member of the set of books. Only books can be members of this set.

09 The set we are going to talk about now is the set of balls. Each ball is a different color. You can bounce every member of this set. You can roll every member of this set, and you can throw every member of this set.

07 Here is one member of the set of balls. You can bounce this ball. You can roll this ball and you can throw this ball. This ball is a member of the set of balls.

10 Now, find envelope number 3 beside your desk. Take three sets from the things you find in the envelope. Place the members of each of the three sets on a different piece of paper.

100 Check your work. Are these the sets you found? There is one set of 1 cars, one set of 3 dolls, and one set of 3 blocks.

10 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

1 Good-bye for now. I'll see you tomorrow and we'll do some more exploring in the basket of sets.

[illegible]

[illegible]

[illegible]

1 Hello! I want you to meet Mr. Mathematics. He's going to help me show you some things about mathematics which you may not have learned before. As you can see, he has three baskets of mathematics: numbers, shapes, and sets. In Mr. Mathematics' first basket are numbers. You probably know about this kind of mathematics. Sometimes we call this kind, arithmetic. There are two other kinds of mathematics in his basket. In Mr. Mathematics' second basket are shapes. In Mr. Mathematics' third basket are sets. We'll be exploring the mathematics in each of Mr. Mathematics' baskets. We'll be studying numbers, shapes and sets.

Today we are going to talk about some of the sets which you see every day. But what is a set? A set is a group of things which go together. We call these things in a set, members of the set.

3 Here is a set you may have seen on the breakfast table this morning. This is a set of dishes. The things in this set go together because they are all dishes. Every member of this set is a dish. The members of this set are two large plates, two small plates, two bowls and two cups. This is a set of dishes.

4 Here is another set you may have seen recently. You may have seen a set like this on the playground. Have you ever swung on a swing? This is a set of swings. Every member of this set is a swing. You can swing on every member of this set.

5 This is one member of the set of swings. You can swing on this set member. Every member of this set is a swing. You can swing on every member of this set.

6 Switch your desk to a large envelope with the numeral one on it. Open the envelope. Take out the piece of paper and crayons. Color the members of the set of dishes red. Color the members of the set of blanks green. Color the members of the set of sunny yellow.

7 Check your work. Do your three sets look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

8 You did very well. Put all of the things back into the envelope. Place the envelope on the floor under your chair.

04 Have you ever had a pet?

0 This set of pets has in it a dog, a cat, and a bird. The pets in this set are each a different color. The dog is brown. The cat is white and the bird is green. But the reason these animals are members of the set is because they are all pets.

03 The dog is a pet. Therefore, he is a member of the set of pets.

03 The cat is also a member of the set because he is a pet.

03 The bird is also a member of the set because he is a pet.

0 The dog, the cat, and the bird make up the set of pets. Every member of the set of pets is a pet.

01 Another set which you see every day is the set of boys. There are sets of boys in your classroom, aren't there? This set of boys has five members. Each boy has a different colored shirt. All of these boys are members of the set. They are all members of this set because they are all boys. A girl could not be a member of this set. Only boys can be members of this set. This is a set of boys.

03 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "2" on it. Open it and put all of the things on your desk. One piece of paper has pictures of many different things. Pick out all of the members of the set of animals and color them yellow. Pick out all of the members of the set of puppets and color them blue. Do not color the things on the paper that do not belong to either set.

010 Check your work. Does the work you have completed on your desk look the same as the picture. If it does not, change your work so that they match.

03 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

03 You probably see this set today in your classroom. This is a set of books. Each of these books is a different color, but you can read every member of this set.

04 You can read the red book. The red book is a member of the set. Any book could be a member of this set.

03 This green book is also a member of the set of books. You can read this green book.

03 All of the books on this table are members of the set. This is a set of books.

66 This baby would not be a member of the set of books. Only books can be members of this set.

67 The set we are going to talk about now is the set of balls. Each ball is a different color. You can bounce every member of this set. You can roll every member of this set, and you can throw every member of this set.

67 Here is one member of the set of balls. You can bounce this ball. You can roll this ball and you can throw this ball. This ball is a member of the set of balls.

68 Now, find envelope number 3 beside your desk. Take three sets. Put an "A" on the members of one set. Put an "A" on the members of one set. Put an "A" on the members of one set.

111 Did you find sets like these? There is one set of 3 cars, one set of 3 dolls, and one set of 3 blocks.

69 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

8 Here is a set you may have seen on the breakfast table this morning. This is a set of dishes. The things in this set go together because they are all dishes. Every member of this set is a dish. The members of this set are two large plates, two small plates, two bowls and two cups. This is a set of dishes.

6 Here is another set you may have seen recently. You may have seen a set like this on the playground. Have you ever swung on a swing? This is a set of swings. Every member of this set is a swing. You can swing on every member of this set.

7 This is one member of the set of swings. You can swing on this set member. Every member of this set is a swing. You can swing on every member of this set.

69 Beside your desk is a large envelope with the numeral one on it. Open the envelope. Take out the piece of paper and crayons. Color the members of the set of dishes red. Color the members of the set of blocks green. Color the members of the set of money yellow.

107 Check your work. Do your three sets look the same as the three sets in the picture. If your sets are not like the sets in the picture, change them to match the sets in the picture.

69 You did very well. Put all of the things back into the envelope. Place the envelope on the floor under your chair.

111

04 Have you ever had a pet?

9 This set of pets has in it a dog, a cat, and a bird. The pets in this set are each a different color. The dog is brown. The cat is white and the bird is green. But the reason these animals are members of the set is because they are all pets.

20 The dog is a pet. Therefore, he is a member of the set of pets.

11 The cat is also a member of the set because he is a pet.

13 The bird is also a member of the set because he is a pet.

9 The dog, the cat, and the bird make up the set of pets. Every member of the set of pets is a pet.

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20 Now, I have a puzzle for you to solve. Find the envelope beside your desk with the numeral "2" on it. Open it and put all of the things on your desk. One piece of paper has pictures of many different things. Pick out all of the members of the set of animals and color them yellow. Pick out all of the members of the set of puppets and color them blue. Do not color the things on the paper that do not belong to either set.

209 Check your work. Does the work you have completed on your desk look the same as the picture. If it does not, change your work so that they match.

20 You did very well. Put the things back into the envelope. Place the envelope on the floor under your chair.

20 You probably saw this set today in your classroom. This is a set of books. Each of these books is a different color, but you can read every member of this set.

24 You can read the red book. The red book is a member of the set. Any book could be a member of this set.

26 This green book is also a member of the set of books. You can read this green book.

Go

33 All of the books on this table are members of the set. This is a set of books.

34 This baby would not be a member of the set of books. Only books can be members of this set.

46 The set we are going to talk about now is the set of balls. Each ball is a different color. You can bounce every member of this set. You can roll every member of this set, and you can throw every member of this set.

47 Here is one member of the set of balls. You can bounce this ball. You can roll this ball and you can throw this ball. This ball is a member of the set of balls.

53 Now find envelope number 3 beside your desk. Make three sets. Put an "X" on the members of one set. Put an "A" on the members of one set. Put an "O" on the members of one set.

111 Did you find sets like these? There is one set of 3 cars, one set of 3 dolls, and one set of 3 blocks.

53 Fine, you are getting the idea. Now, put the things back in the envelope. Place the envelope on the floor under your chair.

1 Good-bye for now. I'll see you tomorrow and we'll do some more exploring in the basket of sets.

APPENDIX III.

CRITERIA FOR THE ASSESSMENT
OF MATHEMATICAL PERFORMANCE
OF CHILD AT SIX COGNITIVE LEVELS

[illegible] MATHEMATICS
POST TEST -- PART A

(#1) Hello there. Today Mr. Mathematics would like to find out how much mathematics you remember from the last few weeks.

(#2000) You remember Mr. Mathematic's friend, Mr. Question. He is going to ask you some questions about mathematics, just like he did when we started the program. Again, you are not expected to answer all of the questions correctly. Just answer as many of them as you can. You may guess at answers you are not sure of. Now find your question envelope. It is in the upper right hand corner of your desk. (stop) Open the envelope and put the cards on your desk, with the card numbered p-one on top. (stop)

(#2001) On your desk you will also find an answer sheet that looks like this. Find the small box on your answer sheet.

(#2002) It is shown in red in the picture. Put your finger on the numeral one in the small answer box. (stop) For each question asked, you will have four different answers to choose from. If you choose answer A, blacken the space under A with your pencil. If you choose answer B, blacken the space under B. If you choose answer C, blacken the space under C. If you choose answer D, blacken the space under D. Follow these directions for every question you answer. Now, take card p-one from your pile of question cards. Turn it over. (stop) Read the question to yourself as I read it to you.

P.1. Which of the pets is a dog? (3 sec. pause)

picture A. (#11 cat) (4 sec. pause)
picture B. (#12 bird) (4 sec. pause)
picture C. (#10 dog) (4 sec. pause)
picture D. (#304 fish) (4 sec. pause)

(#2003) Remember, if your answer is A, blacken the space under A. If your answer is B, blacken the space under B. If your answer is C, blacken the space under C. If your answer is D, blacken the space under D. (stop)

(#2003) Is this the answer you marked? You should have blackened the space under the letter C. (stop)

(#2003) Now take the card that you have just finished and place it, with the question facing up, in the lower right hand corner of your desk. (stop) Whenever you answer a question, place the card, with the question facing up, on the pile in the corner of your desk. Now, put your finger on the numeral 2 in the small box. Find card p-two. Turn it over. (stop) Read the question to yourself as I read it to you.

P.2. Which of the following is a set of horses? (3 sec. pause)

picture A. (#73? horses) (4 sec. pause)
picture B. (#52 fish) (4 sec. pause)
picture C. (#738 chickens) (4 sec. pause)
picture D. (#81 birds) (4 sec. pause)

#3000 If your answer is A, blacken the space under A. If your answer is B, blacken the space under B. If your answer is C, blacken the space under C. If your answer is D, blacken the space under D. (stop)

#3004 Check your work. Did you blacken the space under A? If so, you were correct. (stop)

#3000 Now find the large box on your answer sheet. Find number one. You will answer all of the rest of the questions just as you have done these practice questions. Turn card one over and read it to yourself as I read it to you. Ready? Let's do question one.

(L1-6) 1. Which of the following pictures shows an object which would not be in the set of fruit? (2 sec. pause)

picture A. (#11 apple) (4 sec. pause)
picture B. (#18 orange) (4 sec. pause)
picture C. (#20 grapes) (4 sec. pause)
picture D. (#44 pencil) (4 sec. pause)

#3000(stop)Let's try the next question. Turn card 2 over. (stop)

(L5-4) 2. What does this symbol (#2015) stand for? (4 sec. pause)

A. is equal to (2 sec. pause)
B. is not equal to (2 sec. pause)
C. is equivalent to (2 sec. pause)
D. is greater than (2 sec. pause)

#3000(stop)Let's try the next question. Turn card 3 over. (stop)

(L12-6) 3. Which picture shows a set that this numeral (#402 $\frac{0}{\text{units}}$ $\frac{1}{\text{tens}}$ $\frac{0}{\text{hundreds}}$) does not represent? (7 sec. pause)

picture A. (#3g set of 8 dishes) (7 sec. pause)
picture B. (#404 ten red dots) (7 sec. pause)
picture C. (#405 ten unit sticks) (7 sec. pause)
picture D. (#46 ten balls) (7 sec. pause)

#3000(stop)Let's try the next question. Turn card 4 over. (stop)

(L1-6P) 4. Which picture shows an element that would not be a member of the set of pets? (2 sec. pause)

picture A. (#9 set of pets) (4 sec. pause)
picture B. (#11 cat) (4 sec. pause)
picture C. (#12 bird) (4 sec. pause)
picture D. (#47 ball) (4 sec. pause)

#3000(beep)Let's try the next question. Turn card 5 over. (beep)

(L4-4) 5. This set is a subset of which picture? (#000 girls) (4 sec. pause)

picture A. (#000 boys) (4 sec. pause)
picture B. (#000 tall children) (4 sec. pause)
picture C. (#000 short children) (4 sec. pause)
picture D. (#000 children) (4 sec. pause)

#3000(beep)Let's try the next question. Turn card 6 over. (beep)

(L2-4) 6. Which picture shows a pair of equivalent sets: (3 sec. pause)

picture A. (#0000 4 faces/5 hats) (7 sec. pause)
picture B. (#000 8 helmets/ 8 heads) (7 sec. pause)
picture C. (#000 3 girls/ 5 boys) (7 sec. pause)
picture D. (#000 cats & cars) pets) (7 sec. pause)

#3000(beep)Let's try the next question. Turn card 7 over. (beep)

(L12-4H) 7. What is the answer to this addition problem? (#000 968
(4 sec. pause) +505

A. 1373 (3 sec. pause)
B. 1473 (3 sec. pause)
C. 1373 (3 sec. pause)
D. 1473 (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 8 over. (beep)

(L2-4) 8. Equivalent sets are two sets: (3 sec. pause)

A. with the same number of members. (3 sec. pause)
B. with the same members. (3 sec. pause)
C. with some but not all of the same members. (3 sec. pause)
D. which are the same length. (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 9 over. (beep)

(L20-4H) 9. Which picture shows a pair of shapes that are not congruent?
(3 sec. pause)

picture A. (#1161 red ▽ □'s) (4 sec. pause)
picture B. (#1162 blue ▭ △'s) (4 sec. pause)
picture C. (#1163 purple ▯ ▱'s) (4 sec. pause)
picture D. (#1164 yellow ▭ ▱'s) (4 sec. pause)

#3000(beep)Let's try the next question. Turn card 10 over. (beep)

(L2-4) 10. Which picture shows this relation: 3<□? (3 sec. pause)

picture A. (#000 3 cards/ 5 env.) (7 sec. pause)
picture B. (#000 3 ads./3 birds) (7 sec. pause)
picture C. (#000 8 watches/8 dishes) (7 sec. pause)
picture D. (#000 4 faces/4 hats) (7 sec. pause)

#3000(scop)Let's try the next question. Turn card 11 over. (scop)

(L6-4) 11. What does this sign mean? (#0001 =) (4 sec. pause)

A. is not equal to. (3 sec. pause)
B. is equal to. (3 sec. pause)
C. is a subset of. (3 sec. pause)
D. is equivalent to. (3 sec. pause)

#3000(scop)Let's try the next question. Turn card 12 over. (scop)

(L6-4) 12. Which could not be members of a subset of this set: (#14) cooks) (4 sec. pause)

picture A. (#1Mk short cooks) (4 sec. pause)
picture B. (#1M6 red cooks) (4 sec. pause)
picture C. (#1M5 long cooks) (4 sec. pause)
picture D. (#1J1 blouses) (4 sec. pause)

#3000(scop)Let's try the next question. Turn card 13 over. (scop)

(L15-4) 13. Sarah found 7 hundreds, 4 tens and 14 units for an answer to this problem. (#15) 135) What did she do wrong? Sarah did not: (4 sec. pause) =138

A. regroup the hundreds to give 1 thousands and 3 hundreds (3 sec. pause)
B. regroup the tens to give 4 hundreds and 1 ten. (3 sec. pause)
C. regroup the units to give 1 ten and 4 units. (3 sec. pause)
D. regroup the hundreds to give units and tens. (3 sec. pause)

#3000(scop)Let's try the next question. Turn card 14 over. (scop)

(L15-4) 14. Look carefully at these shapes. (#1156a A) Which two shapes in the picture are congruent? (4 sec. pause)

A. circle and triangle (3 sec. pause)
B. rectangle and square (3 sec. pause)
C. circle and square (3 sec. pause)
D. rectangle and rectangle (3 sec. pause)

#3000(scop)Let's try one more question. Turn card 15 over. (scop)

(L3-4) 15. Which picture shows a set which could not be a subset of this set: (#138 children) (4 sec. pause)

picture A. (#139 boys) (4 sec. pause)
picture B. (#001 girls) (4 sec. pause)
picture C. (#008 black cats) (4 sec. pause)
picture D. (#016 short children) (4 sec. pause)

#3000(scop)You did a very good job of answering the questions. I'll see you tomorrow when we'll answer some more of Mr. Question's questions. Good bye for now. (scop)

#2000 Here's Mr. Question again. You remember him from yesterday. Today we're going to answer more of his questions. Remember how we blackened our answers in the spaces in the large box? Do the same thing today. Now, find your question envelope in the upper right hand corner of your desk. (stop) Card number 16 should be on top of the pile. When you are finished with one question, put that card in the lower right hand corner of your desk, with the question facing up, like you did yesterday. Ready to begin? Turn card number 16 over. Put your finger on numeral 16 in the large answer box, where we left off yesterday. (stop) Now, read card 16 to yourself as I read it to you.

#1060 (L16-1) 16. Tommy found 5 hundreds, 11 tens and six units as his answer to this addition problem. What did he do wrong? (4 sec. pause) Tommy did not:

#1061 #1062 #1063 #1064 #1065 #1066 #1067 #1068 #1069 #1070 #1071 #1072 #1073 #1074 #1075 #1076 #1077 #1078 #1079 #1080 #1081 #1082 #1083 #1084 #1085 #1086 #1087 #1088 #1089 #1090 #1091 #1092 #1093 #1094 #1095 #1096 #1097 #1098 #1099 #1100 #1101 #1102 #1103 #1104 #1105 #1106 #1107 #1108 #1109 #1110 #1111 #1112 #1113 #1114 #1115 #1116 #1117 #1118 #1119 #1120 #1121 #1122 #1123 #1124 #1125 #1126 #1127 #1128 #1129 #1130 #1131 #1132 #1133 #1134 #1135 #1136 #1137 #1138 #1139 #1140 #1141 #1142 #1143 #1144 #1145 #1146 #1147 #1148 #1149 #1150 #1151 #1152 #1153 #1154 #1155 #1156 #1157 #1158 #1159 #1160 #1161 #1162 #1163 #1164 #1165 #1166 #1167 #1168 #1169 #1170 #1171 #1172 #1173 #1174 #1175 #1176 #1177 #1178 #1179 #1180 #1181 #1182 #1183 #1184 #1185 #1186 #1187 #1188 #1189 #1190 #1191 #1192 #1193 #1194 #1195 #1196 #1197 #1198 #1199 #1200 #1201 #1202 #1203 #1204 #1205 #1206 #1207 #1208 #1209 #1210 #1211 #1212 #1213 #1214 #1215 #1216 #1217 #1218 #1219 #1220 #1221 #1222 #1223 #1224 #1225 #1226 #1227 #1228 #1229 #1230 #1231 #1232 #1233 #1234 #1235 #1236 #1237 #1238 #1239 #1240 #1241 #1242 #1243 #1244 #1245 #1246 #1247 #1248 #1249 #1250 #1251 #1252 #1253 #1254 #1255 #1256 #1257 #1258 #1259 #1260 #1261 #1262 #1263 #1264 #1265 #1266 #1267 #1268 #1269 #1270 #1271 #1272 #1273 #1274 #1275 #1276 #1277 #1278 #1279 #1280 #1281 #1282 #1283 #1284 #1285 #1286 #1287 #1288 #1289 #1290 #1291 #1292 #1293 #1294 #1295 #1296 #1297 #1298 #1299 #1300 #1301 #1302 #1303 #1304 #1305 #1306 #1307 #1308 #1309 #1310 #1311

A. regroup the 11 tens as 1 hundred and 1 ten. (2 sec. pause)
B. regroup the 6 units as 1 ten. (2 sec. pause)
C. add right: 6 plus 5 is not equal to eleven. (2 sec. pause)
D. add the units right. (2 sec. pause)

#2000 (stop) Now let's try another question. Turn card 17 over. (stop) #1546

(L17-#2) 17. What is another name for the number represented here? (4 sec.pause)

A. 3 hundreds, 4 tens, 1 unit (2 sec. pause)
B. 3 hundreds, 3 tens, 2 units (2 sec. pause)
C. 3 hundreds, 2 tens, 10 units (2 sec. pause)
D. 3 hundreds, 4 tens, 2 units (2 sec. pause)

#2000 (stop) Let's try another question. Turn card 18 over. (stop)

(L18-4) 18. Which picture shows a triangular region? (2 sec. pause)

picture A. #1111 (4 sec. pause)
picture B. #1112 (4 sec. pause)
picture C. #1115 (4 sec. pause)
picture D. #1021 (4 sec. pause)

#2000 (stop) Let's try the next question. Turn card 19 over. (stop)

(L9-4) 19. Which picture shows this relation: 4 > 21 (2 sec. pause)

picture A. #720 4 horses/3 chickens (2 sec. pause)
picture B. #716 5 hands/4 glasses of milk (2 sec. pause)
picture C. #721 4 flowers/2 children (2 sec. pause)
picture D. #750 3 cards/5 envelopes (2 sec. pause)

#3000(beep)Let's try the next question. Turn card 20 over. (beep)

(L7-A7) 20. Which sentence is a true statement about the relation between eight and nine? (3 sec. pause)

A. 8 = 9 (3 sec. pause)
B. 8 < 9 (3 sec. pause)
C. 9 < 8 (3 sec. pause)
D. 9 > 8 (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 21 over. (beep)

(L8-C) 21. Which picture shows a cat and one of its subsets? (3 sec. pause)

picture A. #130 hands and feet/hands (4 sec. pause)
picture B. #213 4 pl. mitts/4 caddies (4 sec. pause)
picture C. #321 golf clubs/ tennis rackets (4 sec. pause)
picture D. #388 desk/ trucks, bell (4 sec. pause)

#3000(beep)Let's try the next question. Turn card 22 over. (beep)

(L10-A8) 22. Which picture shows a pair of shapes that are congruent? (3 sec. pause)

picture A. #1106 (4 sec. pause)
picture B. #1107 (4 sec. pause)
picture C. #1108 (4 sec. pause)
picture D. #1109 (4 sec. pause)

#3000(beep)Let's try the next question. Turn card 23 over. (beep)

(L12-A) 23. There are more circles than squares because (#0017 combine rubberbands) (4 sec. pause)

A. there is a comb for every rubberband and a rubberband for every comb (3 sec. pause)
B. there is a comb for every rubberband (3 sec. pause)
C. there is a rubberband for every comb (3 sec. pause)
D. there are arrows drawn between them (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 24 over. (beep)

(L13-C) 24. The sum of six and seven is thirteen because (3 sec. pause)

A. six things when put together with seven things makes thirteen things altogether. (3 sec. pause)
B. it is a rule. (3 sec. pause)
C. six critters need to seven makes 13 which is like 13. (3 sec. pause)
D. six sevens makes thirteen. (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 25 over. (beep)

(L5-4F) 25. Which pair of numbers is <u>not</u> equal to each other? (3 sec. pause)

A. ½ and ½ (3 sec. pause)
B. ⅓ and ⅓ (3 sec. pause)
C. ⅞ and ⅞ (3 sec. pause)
D. ⅚ and ⅚ (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 26 over. (beep)

(L5-4F) 26. Which picture shows two sets which have the same number of members (3 sec. pause)

picture A. #326 1 baby and 2 beetles (3 sec. pause)
picture B. #327 3 children holding 4 flowers (3 sec. pause)
picture C. #328 7 comb 6 toothbrushes (3 sec. pause)
picture D. #0433 6 fish on 6 lines (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 27 over. (beep)

(L5-4) 27. Which sentence is <u>not</u> a true greater than statement? (3 sec. pause)

A. $7 > 5$ (3 sec. pause)
B. $4 > 4$ (3 sec. pause)
C. $4 > 2$ (3 sec. pause)
D. $9 > 8$ (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 28 over. (beep)

(L5-4F) 28. What is the answer to this problem? #328 $\begin{array}{r} 732 \\ +156 \\ \hline \end{array}$ (4 sec. pause)

A. 713 (3 sec. pause)
B. 878 (3 sec. pause)
C. 888 (3 sec. pause)
D. 888 (3 sec. pause)

#3000(beep)Let's try the next question. Turn card 29 over. (beep)

(L10-4) 29. An object which would <u>not</u> be in the new set when these two sets (#328 & fraction/3 pieces of pie) are unioned is shown in: (4 sec. pause)

picture A. #29 3 pieces of pie (4 sec. pause)
picture B. #27 apple (4 sec. pause)
picture C. #29 banana (4 sec. pause)
picture D. #321 cookies (4 sec. pause)

#SAM(escape)Let's try the last question. There were 30 more. (beep)

(LIB-4) 30. How do we know that this shape (#1036 ◯) is a circle? It has (# sec. pause)

A. three sides (3 sec. pause)
B. four sides (3 sec. pause)
C. curved sides (3 sec. pause)
D. two sides (3 sec. pause)

#SAM(escape)Again, you did a good job of answering the question and checking your answers. I'll see you tomorrow when we'll answer some more questions. See you then. (beep)

6th MATHEMATICS
POST TEST--PART C

#3000 Hello there. Here's Mr. Question again. Today he's going to ask you some more questions about the mathematics you've learned. You've done very well so far. Just keep in mind that we answer the questions by blackening the space under the letter of the answer we want. Also remember to read the questions to yourself as Mr. Question reads them to you. Now take your question envelope from the upper right hand corner of your desk. Take the cards out. (stop) Card number 31 should be on top of the pile. Find number 31, where we left off yesterday, on your answer sheet. Ready to begin? Turn card 31 over. (stop)

(LB-6) 31. Look at these two sets: (#948 9 fish/1 fish)

Which sentence is a true statement about these two sets? (3 sec. pause)

A. $3 > 10$ (2 sec. pause)
B. $3 < 10$ (2 sec. pause)
C. $9 \geq 1$ (2 sec. pause)
D. $1 \leq 9$ (2 sec. pause)

#3000(stop)Let's try the next question. Turn card 32 over. (stop)

(L1-6) 32. (#960 cat, dish, ball, girl) Why is this group of objects not a set? (4 sec. pause)

A. a set can only have three members. (2 sec. pause)
B. the members of this group do not go together. (2 sec. pause)
C. the members of this group are different colors. (2 sec. pause)
D. a set does not have any members. (2 sec. pause)

#3000(stop)Let's try the next question. Turn card 33 over. (stop)

(L2-6) 33. Which picture shows a set which does not have the same number of members as this set? (#87 6 hands) (7 sec. pause)

picture A. (#58 6 footballs) (7 sec. pause)
picture B. (#71 7 airplanes) (7 sec. pause)
picture C. (#125 6 balloons) (7 sec. pause)
picture D. (#270 6 dowels) (7 sec. pause)

#3000(stop)Let's try the next question. Turn card 34 over. (stop)

(L20-6) 34. Which picture shows a pair of shapes that are congruent? (2 sec. pause)

picture A. (#1160 yellow) (4 sec. pause)
picture B. (#1173 orange) (4 sec. pause)
picture C. (#1167 purple) (4 sec. pause)
picture D. (#1170 orange) (4 sec. pause)

#3000(stop)Let's try the next question. Turn card 35 over. (stop)

(L14-4) 35. Fifty tens is the same as five (2 sec. pause)

A. tens and fifty units (2 sec. pause)
B. hundreds (2 sec. pause)
C. units (2 sec. pause)
D. hundred tens (2 sec. pause)

(stop) Let's try the next question. Turn card 36 over. (stop)

(L6-C) 36. Which of the following pairs of numbers are not equal to one another? (2 sec. pause)

A. 5, 5 (2 sec. pause)
B. 6, 6 (2 sec. pause)
C. 8, 8 (2 sec. pause)
D. 9, 8 (2 sec. pause)

(stop) Let's try the next question. Turn card 37 over. (stop)

(L20-E) 37. (#1145) blue blue) Why are these two shapes congruent? They are the same (4 sec. pause)

A. color. (2 sec. pause)
B. size. (2 sec. pause)
C. shape. (2 sec. pause)
D. size and shape (2 sec. pause)

#3000(stop)Let's try the next question. Turn card 38 over. (stop)

(L2-5) 38. (#0629) 4 spoons) How many numbers are in this set? (2 sec. pause)

A. 5 (five) (2 sec. pause)
B. 6 (six) (2 sec. pause)
C. 4 (four) (2 sec. pause)
D. 9 (nine) (2 sec. pause)

#3000(stop)Let's try the next question. Turn card 39 over. (stop)

(L9-4) 39. Which picture shows these relations:
7 8, 7 8, 8 7? (2 sec. pause)

picture A. #0300 5 bl. and 9 bl. (4 sec. pause)
picture B. #0233 7 bl. and 8 bl. (4 sec. pause)
picture C. #0231 7 bl. and 3 bl. (4 sec. pause)
picture D. #0230 4 bl. and 5 bl. (4 sec. pause)

#3000(stop)Let's try the next question. Turn card 40 over. (stop)

(L13-E) 40. Ten units is equal to (2 sec. pause)

A. 1 ten (2 sec. pause)
B. 2 tens (2 sec. pause)
C. 1 hundred (2 sec. pause)
D. 10 tens (2 sec. pause)

(stop) Let's try the next question. Turn card 41 over. (stop)

(L11-E) 41. This is the new set (#)58 doll, truck, ball, children)
(4 sec. pause) when these two sets (#)66 child/toys) are unioned
because it (4 sec. pause)

A. contains all of the members of the two sets. (2 sec. pause)
B. contains some but not all of the members of the two sets.
(2 sec. pause)
C. is smaller than the two sets. (2 sec. pause)
D. is larger than the two sets. (2 sec. pause)

#)300(stop)Let's try the next question. Turn card 42 over. (stop)

(L3-E) 42. What does this symbol (#)664 $\subset$) stand for? (4 sec. pause)

A. is equal to (2 sec. pause)
B. is a subset of (2 sec. pause)
C. is greater than (2 sec. pause)
D. is less than (2 sec. pause)

#)300(stop)Let's try the next question. Turn card 43 over. (stop)

(L11-AP) 43. Union these two sets: (#)73 4 faces/ 6 hats)

Which picture shows the new set? (4 sec. pause)

picture A. (#)71 4 faces) (4 sec. pause)
picture B. (#)72 6 hats) (4 sec. pause)
picture C. (#)74 faces and hats) (4 sec. pause)
picture D. (#)51 blouses) (4 sec. pause)

#)300(stop)Let's try the next question. Turn card 44 over. (stop)

(L9-E) 44. Look carefully at this picture: (#)1 7 blacksand 3 blacks)

Which number sentence tells about this picture? (7 sec. pause)

A. $7 \not\subset 3$ (2 sec. pause)
B. $3 \supset 7$ (2 sec. pause)
C. $7 = 3$ (2 sec. pause)
D. $7 < 3$ (2 sec. pause)

#)300(stop)Let's try one more question. Turn card 45 over. (stop)

(L16-AP) 45. (#)956 $+\frac{253}{059}$) Find the answer to this problem. The correct
answer is (4 sec. pause)

A. 812 (2 sec. pause)
B. 831 (2 sec. pause)
C. 822 (2 sec. pause)
D. 723 (2 sec. pause)

#)300(stop) You have done a very good job of answering the questions. See you
tomorrow when Mr. Question will be back again. Good bye for now.
(stop)

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CMI MATHEMATICS
POST TEST -- PART B

(#3000) Hello there. Here's Mr. Question again. Today he's going to ask you some more questions about the mathematics you've learned. You've done a very good job so far. Just keep in mind that we answer the questions by blackening the space under the letter of the answer we want. Also remember to read the questions to yourself as Mr. Question reads them to you. Now take your question envelope from the upper right hand corner of your desk. (stop) Take the cards out. Card number 46 should be on top of the pile. Find number 46, where we left off yesterday, on your answer sheet. (stop) Ready to begin? Turn card 46 over.

(L3-4) 46. A subset is (2 sec. pause)

A. a set which is part of another set. (2 sec. pause)
B. the number which tells how many members the set has. (2 sec. pause)
C. an empty set. (2 sec. pause)
D. a set which has the same number of members as another set. (2 sec. pause)

(stop) Let's try the next question. Turn card 47 over. (stop)

(L10-4) 47. To union two sets means (2 sec. pause)

A. to put the members of the two sets together to make a new set. (2 sec. pause)
B. to make a new set by adding some but not all of the members of another set. (2 sec. pause)
C. to choose some of the members of a set and put them into a new set. (2 sec. pause)
D. to count the members in the sets. (2 sec. pause)

(stop) Let's try the next question. Turn card 48 over. (stop)

(L14-4) 48. Ten tens is equal to (2 sec. pause)

A. 10 units (2 sec. pause)
B. 1 hundred (2 sec. pause)
C. 10 hundreds (2 sec. pause)
D. 15 units (2 sec. pause)

(stop) Let's try the next question. Turn card 49 over. (stop)

(L10-4) 49. Which picture shows two sets which were not unioned to get this set? (#364 doll, truck, ball) (4 sec. pause)

picture A. (#387 toys/ [illegible]) (4 sec. pause)
picture B. (#388 doll/truck, ball) (4 sec. pause)
picture C. (#389 doll, truck/ball) (4 sec. pause)
picture D. (#369 truck, ball, doll, boy and girl) (4 sec. pause)

#3000(stop)Let's try the next question. Turn card 10 over. (stop)

(L1)-C) 10. We can regroup fourteen tens as one hundred and 4 tens because (2 sec. pause)

A. 14 = 14 (2 sec. pause)
B. 10 tens = 1 hundred (2 sec. pause)
C. 10 hundreds = 1 ten (2 sec. pause)
D. 10 units = 1 ten (2 sec. pause)

(stop) Let's try the next question. Turn card 11 over. (stop)

(L1)-A) 11. Five plus six equals (2 sec. pause)

A. eleven (11) (2 sec. pause)
B. ten (10) (2 sec. pause)
C. seven (7) (2 sec. pause)
D. twelve (12) (2 sec. pause)

(stop) Let's try the next question. Turn card 12 over. (stop)

(L)-C) 12. Which picture shows a set and one of its subsets? (2 sec. pause)

picture A. (#316 sailboats/lifejackets) (4 sec. pause)
picture B. (#152 dishes/ large plates) (4 sec. pause)
picture C. (#271 holes/donuts) (4 sec. pause)
picture D. (#366 children/toys) (4 sec. pause)

#3000(stop)Let's try the next question. Turn card 13 over. (stop)

(L1)-C) 13. Which picture shows a pair of shapes that are congruent. (2 sec. pause)

picture A. (#1105) (4 sec. pause)
picture B. (#1108) (4 sec. pause)
picture C. (#1110) (4 sec. pause)
picture D. (#1144) (4 sec. pause)

#3000(stop)Let's try the next question. Turn card 14 over. (stop)

(L1)-A) 14. The answer to this problem (#950 $38) (4 sec. pause) and this problem (#95) $16) +$15 (4 sec. pause) is
+$38

A. 754 (2 sec. pause)
B. 764 (2 sec. pause)
C. 854 (2 sec. pause)
D. 745 (2 sec. pause)

#3000(stop)Let's try the next question. Turn card §5 over. (stop)

(L2-C) §5. To find the number of members in a set, I would (2 sec pause)

A. add the members. (2 sec. pause)
B. subtract the members. (2 sec. pause)
C. put the members together to make a new set. (2 sec. pause)
D. count the members. (2 sec. pause)

(stop) Let's try the next question. Turn card §6 over. (stop)

(L12-S) §6. (#§46 hundreds tens units) A name for this number is (4 sec. pause)

xxx xx xxxx

A. } hundreds, 2 tens, 14 units (2 sec. pause)
B. } hundreds, } tens, 2 units (2 sec. pause)
C. } hundreds, } tens, } units (2 sec. pause)
D. } hundreds, } tens, 0 units (2 sec. pause)

#3000(stop)Let's try the next question. Turn card §7 over. (stop)

(L15-A) §7. A triangle is a shape with (2 sec. pause)

A. four equal sides. (2 sec. pause)
B. three sides. (2 sec. pause)
C. no sides. (2 sec. pause)
D. two pairs of equal sides. (2 sec. pause)

(stop) Let's try the next question. Turn card §8 over. (stop)

(L12-C) §8. A "2" in the tens place means we have how many things in our set? (2 sec. pause)

A. two (2). (2 sec. pause)
B. twenty (20). (2 sec. pause)
C. two-hundred (200). (2 sec. pause)
D. twelve (12). (2 sec. pause)

(stop) Let's try the next question. Turn card §9 over. (stop)

(L16-A) §9. The sum of nine and five is (2 sec. pause)

A. 1 ten and 4 units. (2 sec. pause)
B. 2 tens and 4 units. (2 sec. pause)
C. 2 tens and 4 units. (2 sec. pause)
D. 9 tens and 5 units. (2 sec. pause)

(stop) Let's try the next question. Turn card 60 over. (stop)

(LII-C) 60. The new set formed when (#77) 4 faces/5 hats) these two sets are unioned is shown by: (4 sec. pause)

picture A. (#77) 4 faces, 5 hats) (4 sec. pause)
picture B. (#77) 5 hats) (4 sec. pause)
picture C. (#77) 4 faces) (4 sec. pause)
picture D. (#71) 2 men/3 trucks) (4 sec. pause)

#3000(stop)Let's try the last question. Turn card 61 over. (stop)

(LIV-C) 61. A name for this number is: (#622 1 hundred block, 6 ten blocks, 2 unit blocks) (4 sec. pause)

A. 162) (2 sec. pause)
B. 162 (2 sec. pause)
C. 062) (2 sec. pause)
D. 162) (2 sec. pause)

#3000(stop)Now, you have finished the test and all of the lessons. You have done an excellent job of showing Mr. Question how much mathematics you've learned. You have also been a very good pupil for all of the lessons. We hope to see you again soon. Until then, good bye.